The Penn State McNair Journal

Summer 2012, Summer 2013, Summer 2014 Volume 19

The Penn State McNair Journal is published annually and is the official publication of the Ronald E. McNair Scholars Program at Penn State. No responsibility for the views expressed by the authors in this journal is assumed by the editors or the Ronald E. McNair Scholars Program.

Copyright 2014 by the Ronald E. McNair Scholars Program at Penn State, all rights reserved.

The program is funded annually by a $296,234 Ronald E. McNair Post-Baccalaureate Achievement Program grant from the U.S. Department of Education.

THE PENN STATE MCNAIR JOURNAL

Summer 2012, Summer 2013, Summer 2014 Volume Nineteen

Table of Contents

Welcome from the Penn State McNair Scholars Program……...…….……..…...vi

TRIO Programs on the National Level…….…….……..….….vii

TRIO Programs at Penn State ……..…….…….……..…..vii

McNair Scholars Program at Penn State…….….….….…….….viii

McNair Scholars Summer 2012 Scholars and Staff…….……viii

McNair Scholars Summer 2012 Scholars and Staff…….……..…ix

McNair Scholars Summer 2012 Scholars and Staff…….…….….ix

About Ronald E. McNair……..……..….……x

Special Acknowledgements…….…….....xi

2012 Summer McNair Scholar Articles

New York City's High Line: Participatory Planning or Gentrification?
Ariel B. Alvarez.…….……1

Total sexual selection on men's voices
Jason N. Bundy……..…….……|…..15

I Want to Live Again: an Existential Analysis of It's a Wonderful Life
Joshua J. Gleim..….……..…….…….……..……...31

Does Travel Broaden the Communicative Mind? The Influence of Crawling on the Development of Communication in the First Year of Life
Ricky David Groner II……..…….……..……..…….....44

Does it make a difference? An Examination of Intensive Academic and Social Supports Influence on Students of Color Post-Secondary Attendance
Roseilyn Guzman.……..……..…...59

Beyond Bias and Accuracy: A Review of Analysts' Forecast Process
Yibing Lin…….……..…….…...….71

Mirror, Mirror, In the Eyes: Mental State Decoding Abilities in Pathological Narcissism
Neil A. Meyer……84

The Dopamine Transporter and Risk-Taking Behavior: The Role of Genetics in Addiction
Faith Pettyjohn……105

Buying Early Education: The Role of Parental Motivation in Preschool Consumption
Jina Prince……123

A Longitudinal examination of Parent-Adolescent Conflict, Romantic Relationship Conflict, and Depressive Symptoms among Mexican-origin Adolescent Females
Dayanna M. Reeves……134

Bayesian Inference for Bilingual Word Learning
Sebastian Rolotti……147

2013 Summer McNair Scholar Articles

Real-time State of Vigilance Detection for Probing Seizure Mechanisms and Seizure Control
Andrew Alexander……167

Functional Changes Related to Episodic Memory in People with Traumatic Brain Injury
Jason A. Blake……175

Detecting Stopping Track Muons with the IceCube Neutrino Observatory
Crispin Contreras……188

The Implications of Early Family Experiences for Adolescents' Perceived Romantic Competence
Kenya M. Crawford……198

An Analysis of the Self-Identification of Algerian Novelists Mouloud Feraoun and Yasmina Khadra and their French Education
Brooke Durham……213

Fusobacterium varium Infection in Mice as a Model for the Study of Vaccine Efficacy and Immunogenicity
Catherine M. Guerra……250

African Americans at PWIs: The Role of Race Consciousness and Ethnic Identity in Predicting Mental Health
Charles Lawson……...……**……**…….…… ….……..259

Exploring the relationship of participation and connectedness in afterschool programs to problem behavior
Rhoda Moise……...……..…… ….……..… ……274

Access to Quality Caregiver Resources: Assessing the Role of Race and Economic Status in the Personal Experiences of Parents Raising Children with Autism Spectrum Disorders
Angelique Murillo……...…….…..…….…...…….....294

Performance Evaluation of the Radon Transformation in Limited Angle Radar Tomography
Joshua Alton Noble….……..…….……....301

The Role of Peroxisome Proliferator-Activated Receptor-β/δ (PPARβ/δ) in the Human MCF7 Breast Cancer Cell Line
Dylan Phillips.……...…….……..……..….….....309

Migration, Race and Identity: Arab Migration and its Impact on Cuban Society
Leslie Sotomayor..…..…….….…..324

Communication Problems between Caregivers and Individuals with Dementia: Implications for Caregiver Well-being
Jeanna Stiadle……...…….……...…….....351

The Impact of Endophytic Fusarium verticillioides on Corn Growth and Protein Composition
Patrick Thomas……..…….……..376

2014 Summer McNair Scholar Articles

No Mujeres, No Money: Gender Inequality and Development in Latin America
Brooke L. Abrams…….…….…390

Characterizing the Regulation of tfoX in Vibrio fischeri
Haikel N. Bogale….……..…….……|….410

Risky Business: Young Adults' Sexual Attitudes and their Impact on Intervention Effectiveness
Taryn Codner…...…….……...…….....416

Can Neighbors Make You Healthy? Understanding how adolescent obesity is associated with neighborhood characteristics and physical activity
Charnice A. Culmer..…….……..….....424

The Politics of Participation: The Association Between School Racial Composition and Civic Engagement Later in Life
Sheryl-Amber Edmondson..……..……..……..439

A Critical Examination of Diversity in Caregiving: Care Provision for African Americans with Dementia
Jazmine Gordon…..……….……..……..458

Are Interpersonal Strengths Associated with Academic Achievement and Interests?
Carolina A. Ribo…..……….…..……..468

Effects of Crop Management Practices on the Soil Health Indicators—Water Stable Aggregates and Soil Organic Matter
Samantha P. Rosado…...……..……..……...……488

Modeling Photoacoustic Tomography using k-Wave
Jonathan C. Russell……...……..……....501

Heuristic Repression: Why Modern Latin American Dictatorships Target Underrepresented Racial Groups
Shidhara Torres.……..…….……509

WELCOME

Since 1991, the Penn State McNair Scholars Program has enriched the lives of students at Penn State. The McNair Program holds a very special place in our lives, as well as in the lives of the faculty and staff who work with our students. This publication celebrates their achievements and we offer it to our readers with pride and pleasure.

This is the nineteenth issue of the Penn State McNair Journal. We congratulate the Penn State McNair Scholars and their faculty research advisors! This journal presents the research conducted in the summers of 2012, 2013 and 2014 by undergraduate students from Penn State who were, and some who are still enrolled, in the Penn State McNair Scholars Program.

The articles within this journal represent many long hours of mutual satisfying work by the Scholars and their professors. The results of their research are published here and have also been presented at various research conferences around the country. We are especially proud to see how these students have grown as researchers and scholars. The hard work, dedication, and persistence required in producing new knowledge through research is most evident in these articles.

We very much appreciate the guidance, expertise, caring and patience of our fine group of Penn State faculty research advisors. For their ongoing support and assistance, we thank Eric Barron, President of Penn State University; Nicholas Jones, Provost; Regina Vasilatos-Younken, Interim Dean of the Graduate School; Suzanne Adair, Assistant Dean, and Stephanie Danette Preston, Senior Director of the Office of Graduate Educational Equity Programs, the administrative home of the McNair Scholars Program.

We are also fortunate to have the support and encouragement of many faculty and staff members who have worked with our students as social mentors or who have presented workshops and seminars on the many aspects of graduate and faculty life. You give the most precious of gifts to our students – your time in volunteering to support, encourage and nurture our Scholars' hopes and dreams.

Project Director

TRIO PROGRAMS ON THE NATIONAL LEVEL

Since their establishment in the mid-sixties as part of Lyndon Johnson's War on Poverty Program, the federal TRIO Programs have attempted to provide educational opportunity and make dreams come true for those who have traditionally not been a part of the educational mainstream of American society. The TRIO programs are funded under Title IV of the Higher Education Act of 1965. While student financial aid programs help students overcome financial barriers to higher education, TRIO programs help students overcome class, social and cultural barriers to higher education. There are eight TRIO programs, which include the original three – Upward Bound, Talent Search and Student Support Services. The additional programs are Educational Opportunity Centers, Upward Bound Math & Science Centers, the Ronald E. McNair Post-Baccalaureate Achievement Program, Veterans Upward Bound, and a training program for TRIO staff. McNair programs are located at 156 institutions across the United States and Puerto Rico. The McNair Program is designed to prepare participants for doctoral studies through involvement in research and other scholarly activities.

TRIO PROGRAMS AT PENN STATE

The ten TRIO Programs at Penn State comprise six of the eight TRIO programs. There is the Educational Opportunity Center serving Philadelphia, two Talent Search Programs serving select western Pennsylvania school districts and the York City school district, the Ronald E. McNair Scholars Program serving the University Park campus, three Student Support Services Programs serving the Greater Allegheny, Wilkes-Barre and University Park campuses, the Upward Bound and Upward Bound Migrant Programs serving central and southeastern Pennsylvania select school districts, and the Upward Bound Math and Science Program serving select southeastern Pennsylvania school districts. These programs annually serve more than 6,000 students, from 6th graders through adults, all with clear potential for academic success. Altogether, the programs operate across select Penn State campuses and in communities across the state, often linking with middle schools, high schools, and community agencies. The programs focus on helping students overcome economic, social, and class barriers so that they can pursue education beyond high school.

MCNAIR SCHOLARS PROGRAM AT PENN STATE

Designed for low-income and first-generation college students, and students from groups underrepresented in graduate education, the McNair Scholars Program at Penn State encourages talented undergraduates to pursue the doctoral degree. The program works closely with these participants through their undergraduate career, encourages their entrance into graduate programs, and tracks their progress to successful completion of advanced degrees.

The goal of the McNair Program is to increase graduate degree attainment of students from the above-mentioned underrepresented segments of society. McNair Scholars are presented with opportunities to study and do research in the University's state-of-the-art facilities in order to hone those skills required for success in doctoral education. Through both academic year and summer program components, McNair Scholars are required to complete a series of steps that lead to their application and enrollment in a graduate program of their choice.

Since 1991, the McNair Scholars Program at Penn State has helped 260 students earn their baccalaureate degrees. Of these graduates, 222 or 85 percent have gone on to graduate school at institutions across the country and overseas. As of September 2014, 52 or 23 percent have earned their academic or professional doctorates. Of this group, 21 also earned their master's degrees prior to the doctorate. Another 82 or 37 percent have now earned their master's degrees only. Currently, there are 70 or 32 percent of alumni who are still enrolled in graduate programs. Among the institutions McNair alumni have attended or now attend are: Arizona State, Boston University, Columbia, Cornell, Harvard, Howard University, Indiana University, Iowa State, Johns Hopkins, New York University, Ohio State, Penn State, Purdue, Stanford, Temple, Texas A&M, UC-Berkeley, UC-Davis, UCLA, University of Chicago, University of Florida, University of Illinois-Urbana Champaign, University of Maryland-College Park, University of Michigan, University of North Carolina-Chapel Hill, University of Pennsylvania, University of Texas, University of Wisconsin and Yale, to name just a few.

Summer 2012 McNair Scholars and Program Staff

Summer 2012 Penn State McNair scholars and program staff gather together during the 2012 Penn State McNair-SROP Summer Research Symposium held July 23-24, 2012 at University Park.

Summer 2013 McNair Scholars and Program Staff

Summer 2013 Penn State McNair scholars and program staff gather together during the 2012 Penn State McNair-SROP Summer Research Symposium held July 22-23, 2013 at University Park.

Summer 2014 McNair Scholars and Program Staff

Summer 2014 Penn State McNair scholars and program staff gather together during the 2012 Penn State McNair-SROP Summer Research Symposium held July 28-29, 2014 at University Park.

ABOUT RONALD E. MCNAIR

Dr. Ronald Erwin McNair, the second African American to fly in space, was born on October 21, 1950, in Lake City, South Carolina. In 1971, he received a Bachelor of Science degree, magna cum laude, in physics from North Carolina A&T State University. He continued his education at the Massachusetts Institute of Technology (MIT) where, in 1976, he earned his Ph.D. in physics.

While at MIT, McNair performed some of the earliest development of chemical and high-pressure CO lasers. He went on to study laser physics at E'cole D'ete Theorique de Physique in Les Houches, France. He was well published and nationally known for his work in the field of laser physics through the Hughes Laboratory.

In 1978, McNair realized his dream of becoming an astronaut when he was selected from a pool of several thousand applicants to be included in the first class of thirty-five applicants for the space shuttle program. Ronald McNair and six other astronauts died on January 28, 1986 when the space shuttle *Challenger* exploded after launching from the Kennedy Space Center in Florida.

McNair was an accomplished saxophonist; held a sixth-degree, black belt in karate; and was the recipient of three honorary doctorates and a score of fellowships and commendations. He was married to the former Cheryl Moore and is the father of two children, Reginald Ervin and Joy Cheray. After his death, Congress approved funding to honor the memory of McNair by establishing the Ronald E. McNair Post-Baccalaureate Achievement Program, which became the sixth program funded under the TRIO Programs umbrella.

"Historians, who will write about McNair, the man, will discover that there was much more to him than his scholastics achievements. Friends who knew him, say he walked humbly and never boasted about his achievements. They say his commitments were to God, his family and to the youths he encouraged to succeed."
(Ebony, May 1986)

SPECIAL ACKNOWLEDGEMENTS

PROGRAM AND EDITORIAL STAFF
Tammy Dudick, Administrative Support Assistant
Alexandria Lockett, former Writing Advisor
Edward McKeon, former Academic Coordinator
Teresa Tassotti, Program Director

MCNAIR RESEARCH METHODS COURSE INSTRUCTOR
Rama Radhakrishna

MCNAIR SUMMER WRITING ADVISOR
Alexandria Lockett

2012 SUMMER FACULTY RESEARCH ADVISORS AND PAPER EDITORS
Mayra Bamaca
Rick Gilmore
Henock Louis
Steven Huddart
Susan Lemieux
Kenneth N. Levy
Ping Li
Leticia Oseguera
David A. Puts
Maryellen Schaub
Shannon Sullivan
Darrell Velegol
Stephanie Velegol
Stephen J. Wilson
Melissa W. Wright

2013 SUMMER FACULTY RESEARCH ADVISORS AND PAPER EDITORS
Clemente Abrokwaa
Jason W. Brooks
Douglas Cowen
Solsiree Del Moral
Erinn Finke
Bruce J. Gluckman
Frank Hillary
Gretchen A. Kuldau
Susan M. McHale
Ram Narayanan
Jeffrey M. Peters
Janina Safran
Emilie P. Smith
Jose Soto

Christine E. Stanik
Pei-Li Yao
Steven H. Zarit

2014 SUMMER FACULTY RESEARCH ADVISORS AND PAPER EDITORS

H. Harrington Cleveland
Gretchen G. Casper
Lori A. Francis
Erica Frankenberg
Heather Karsten
Sinfree Makoni
Glenna Malcolm
Tim Miyashiro
Aaron L. Pincus
Suet-ling Pong
Richard L. Tutwiler
Joseph G. Wright

2012 SOCIAL MENTORS

Lorraine Dowler
Mark Ballora
Irene Harvey
Cathy Hunt
Jordan West
Angelique Bacon-Woodard
Alex Yin
Kenneth Levy
D'Andre Wilson
Maria Schmidt
Keith Wilson
Lori Francis
Nola Stephens
Ping Li
Alex Yin

2013 SOCIAL MENTORS

Peter Arnett
Richard Robinett
Jennifer Crissman Ishler
Kathyrn Gines
Jason W. Brooks
Earl Merritt
Angelique Bacon-Woodard
Jonte Taylor
John Mitchell
Jeffrey M. Peters

Ann Shostrum
Robert Prosek
Derek James

2014 SOCIAL MENTORS

Eli Byrne
Elizabeth Carlson
Ann Marie Daniel
Charles Geier
Wayne Gersie
Tim Miyashiro
Andrew Peck
James Sellmer
Tina Thomas

New York City's High Line: Participatory Planning or Gentrification?

Ariel B. Alvarez, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Melissa W. Wright, Ph. D
Professor of Geography and Professor of Women Studies
College of Earth and Mineral Sciences
The Pennsylvania State University

Abstract

In the last fifty years, participatory planning methods have been utilized by practicing urban planners because they emphasize citizen involvement and equitable representation of disempowered community members. This paper analyzes the degree to which the nonprofit organization and self-proclaimed community group Friends of the High Line facilitated citizen input during remediation of an abandoned elevated freight-car railway, the High Line, into a public park in West Chelsea, New York City. Findings suggest that the High Line is an atypical example of a community driven urban revitalization project and that the participatory planning model may need to be redefined when applied to affluent communities.

Introduction

The innovative and sleekly designed public High Line park running from Ganesvoort St. to West 20th St. in Manhattan, New York was once considered to be nothing more than an unsightly relic of New York City's industrial past. Property developers viewed the elevated idle freight car line as a hindrance to potential economic development for the neighborhood while most West Chelsea residents paid little attention to the massive metal structure that had simply morphed into the mundane, industrial urban landscape (High Line History 2010).

However, once discussion about demolishing the High Line began amongst members of the Chelsea Property Owners, a group seeking to develop real-estate below the railway, and the former New York City Giuliani administration, two West Chelsea community residents Robert Hammond and Joshua David initiated a grassroots nonprofit organization known as Friends of the High Line. Friends of the High Line saved the railway from demolition and remediated it into the thriving public park it is today. Hammond and David founded this nonprofit in order to save an intriguing piece of New York City history that would not only increase tax revenues for the entire city of New York, but more specifically enrich the West Chelsea community financially with the implementation of new business and increased property values resulting from the new real-estate developments (David 2002). However, Friends of the High Line is not only recognized for revitalizing the West Chelsea area; their efforts to maintain the park as a community-initiated project and to continue to cultivate the dynamic surrounding community of West Chelsea have also been critically acclaimed by external onlookers (p. 127; Friends of the High Line).

For example, the Rockefeller Foundation bestowed the Jane Jacobs Medal to Hammond and David as a way to recognize their innovative creation of a "more diverse, dynamic, and equitable city" (Itzkoff 2010; Jane Jacobs Medal). Due to such positive feedback, cofounders Hammond and David, go so far as to define the High Line as being a bottom-up project (2011, p. 127). Despite this affirmative publicity, further research and explanation of Friends of the High Line's efforts for community engagement is necessary. By questioning their methods of community involvement, I intend to analyze the group's role in incorporating citizen participation in the High Line project. When installing future projects in urban public spaces, this analysis of the High Line can serve as a model for further innovation in the participatory planning method that continues to be a dominant topic of conversation within the field of urban planning.

In the last fifty years, participatory planning and its implementation within American urban planning have reshaped the theoretical discussion of urban design as well as its impact on the built environment in communities. Emerging out of widespread community activism during the 60s and 70s, participatory planning generally alludes to the inclusion of everyday, ordinary people within the planning decisions of their communities (Innes 1995). Most notably, the 1961 publication *The Death and Life of Great American Cities* by Jane Jacobs, a charismatic community activist, is generally identified as the cornerstone of participatory planning that ignited the discussion about optimal methods of citizen inclusion and if such attempts should be a priority in the urban planning profession (1961).

In the years leading to Jacob's writing of Death and Life, World War II American cities had been transformed by the top-down approaches of urban renewal. Federal legislation such as the Housing Act of 1949 and the Amending Act of 1954, endowed urban planners and local governments with abounding and irrevocable authority to clear entire neighborhoods deemed as "blighted" (Hall 2002, p. 247). However, as destruction of neighborhoods in New York City, Chicago, and numerous other cities occurred, local residents became increasingly enraged at their displacement from their homes and neighborhoods. Excluded from paramount planning decisions that drastically altered community structure and ignored neighborhood values, residents finally protested and compelled urban planners to reevaluate their top-down planning methods (Hall 2002, p. 249).

Planners such as Robert Moses, the "Master Builder" of 1940s-60s New York City, was the most distinct example of a top-down planner whose decision-making techniques as an uncontested expert sparked an outcry from concerned residents. Jane Jacobs, a resident herself of Greenwich Village, assessed the possibility of her own neighborhood being destroyed as a repercussion to Moses' urban renewal proposal for a Lower Manhattan Expressway project (Hall 2002, p. 253). With the looming threat of her own neighborhood's destruction, Jacobs's noteworthy book came at an opportune moment in which her ideas inspired community activism among local citizens and planners across the nation. Specifically, her challenge to Moses and the visions he had for developing lower Manhattan have had a lasting impact on the participatory planning discussion that continues to pervade the urban planning profession to this day.

As such, her ideas signaled the beginning of a dynamic conversation germane to the nature of participatory planning and the best tactics for its execution. Varied terms such as "advocacy planning," "communicative planning," and "transformative planning" emerged (Klemeck 2009, pg. 76; Fainstein 2000, pg. 456; Friedmann 2011). Despite variations in terminology, all planners who abide to community participatory methods strive to authentically include citizens in the planning process of their urban localities.

While the planning profession has evolved over time due to its history and the ongoing discussions that have ensued, a closer analysis of nonprofit organizations' roles in further facilitating resident participation in urban revitalization projects is necessary for improving how planners, government officials, and residents interact to create truly public open spaces for the entire community. This paper will analyze, through Jacobs' lens of planning, the extent to which the nonprofit organization, Friends of the High Line, utilized participatory planning methods to engage the West Chelsea community in the planning and design decisions for the New York City public park, the High Line.

Literature Review

To begin, a discussion of the literature regarding the evolution of participatory planning theory and its physical practice will provide a basis for discerning the Friends of the High Line's effective utilization or lack thereof of participatory planning methods meant to facilitate community input in the planning of the public park, the High Line. A brief explanation of the role of urban planners and the two main ways in which they can approach urban communities during the planning and design phases of a project will additionally be included. Furthermore, the role of nonprofit organizations in relation to community planning will be discussed. Finally, I will provide brief background about the origins of Friends of the High Line and its motive for saving the High Line from demolition and repurposing it into a public park. This information will provide the context necessary for examining the group's status as a community-oriented organization within the urban planning structure of New York City.

According to Damon Y. Smith, an Assistant Professor of Law at Rutgers School of Law-Camden, the average community planner has two options of top-down planning or bottom-up planning. Top-down planning disregards the needs and wants of the local citizens within particular communities. Instead, more focus is centralized around the methods of eminent domain and tax abatement (2009, p. 245), precisely tactics that Robert Moses employed during his reign (Hall 2002, p. 249). Therefore, rather than listening to residents' concerns, officials who engage in this hierarchical system of structuring city spaces enforce changes based on their assumed knowledge as professional experts. Top-down planners view cities as homogenous systems that can be shaped into a clearly defined vision while ignoring the particularities of each distinct space. According to Jacobs, they ignore the interconnecting factors that constitute the inherently complex system of a city. Rather than seeking residents' colloquial and informal knowledge of the spaces in question, top-down planners treat the city as a simple entity that has a one-size fits all solution and a generic set of infallible rules (Jacobs 1961, pg. 432-435).

Jacobs, by contrast, described cities as diverse entities that cannot be shaped by a solitary formula because they possess an inherent fabric of "unaverage,"distinct markers (Jacobs 1961, p. 443). She argued that the most appropriate way to account for these significant markers is to apply the alternative approach of bottom-up planning, which, according to Smith, consists of working with municipal officials and local residents to collaboratively develop revitalization plans attuned to particular communities (2009, p. 245). These local residents can ideally identify unusual people or events within their neighborhoods because of their daily encounters with them. Every day, ordinary people's frequent interaction and knowledge of the normal rhythms of their neighborhood suggests their perception of their roles in the community, thus making their delineation of significant city markers more valuable than the offhanded analysis of the expert planner (Jacobs 1961, p. 443). This second approach of bottom-up planning facilitates and

advocates for participatory planning, a method which incorporates residents' perspectives in the planning phases of city plans (Smith 2009, pg. 245).

As already indicated, participatory planning emphasizes the roles of the citizen and the resident within the planning process of urban community plans, which ultimately benefits the community residents and contributes to the success of a final urban project. Day, for example, recognizes that most of the literature credits participatory methods for compelling administrative powers to be more responsive and democratic, a practice of which Jacobs called for when criticizing the anachronistic administrative and planning structure of the 1960s New York City Planning Commission (1997, pg. 424; Jacobs 1961, pg. 407). Additionally, citizen participation allows for community residents to become educated about issues directly affecting their lives. Day argues that once they become aware of pressing concerns, citizens feel more connected to the community and personally assume the neighborhood issues as their own (Day 1997, pg. 424). Ideally, future enacted policy should be representative of citizen desires as a result of initial citizen inclusion in the preliminary planning phases of urban public projects. Urban plans can then possess a finer chance of reflecting true resident sentiment, as participation enables residents to obtain and to perform substantial control over the environments they themselves inhabit (Day 1997, pg. 424).

More importantly, Sherry R. Arnstein, a former U.S. Department of Housing and Urban Development official, specifies participatory planning's fundamental goal of incorporating disadvantaged citizens, or those generally excluded from political and economic processes, as being the paramount reason for its utilization in the profession (Arnstein 2007, p. 216; Checkoway 1994, p. 139). According to Michael Rios, Assistant Professor in the landscape architecture department at the University of California Davis, presenting "multiple publics" or groups with "diverse values and rhetoric" is also significant when employing participatory planning methods (Rios 2004, p. 122). He further argues that commonalities can be discovered among differing social groups only when such groups precisely articulate their salient differences. However, this type of dialogue can only be achieved when all social groups or "multiple publics" are included in the public realm of participation (Rios 2004, p. 121). Therefore, citizen participation is not legitimate unless all groups, the disempowered and the affluent are equitably represented and sincerely regarded.

While the positives of participatory planning are admirable, there are drawbacks that coincide with the underlying nebulous notion of democracy. There is no clear consensus about the potential that democracy as a system of governance holds for urban planning and community participation because fundamental and ideological differences undoubtedly remain amongst various sectors in a representative society (Grant 1984, p. 202). For example, dominant cultural values and beliefs can pervade a diverse community of differing social systems, and thus expose the fact that there are multiple perceptions of what constitutes a "good community" (Grant 1984, p. 4). Therefore, the "multiple publics" that Rios suggests should be fairly recognized when making planning decisions, can also pose the problem of amplifying dissent among groups with alternative backgrounds and values (Grant 1994, p. 9).

In addition to multiple groups' differing prerogatives and end goals, the prospect of certain groups wanting to exclude others from the planning process is another negative of the participatory planning model (Grant 1994). Susan S. Fainstein, Professor of Urban Planning and Design at the Harvard Graduate School of Design, claims that whether deliberately or unintentionally, the group deficient of "money, access to expertise, effective organization, and media coverage," generally suffers from being underrepresented and ignored. Only when these

resources are available does the intended transparency of participatory planning truly emerge and create constructive citizen participation (2000, p. 461).

Another negative of citizen participation in urban community plans can be the daunting amount of time that passes with little tangible action occurring after hours of dialogue. Fainstein (2000) states that the extensive time spent formulating plans representative of various community facets disillusions participants who were initially inspired to generate designs beneficial to their community (p. 460). Citizens may eventually view the entire planning process as pointless, as many of their objectives are pushed to the side for long periods of time (Fainstein 2000, p. 460). As a result, they tend to view their role and contributions to the planning process as ineffective and nugatory (Grant 1994, p. 13). Residents become jaded and uninspired about the leverage they actually possess in a representative community founded on democracy.

Furthermore, participatory methods often produce manufactured consensus among groups (Rios 2004, p. 123). In other words, feigned agreement among groups of varying interests may be established through inauthentic dialogue and seemingly rehearsed conversation that culminates in a predetermined decision (Jacobs 1961, p. 406). Whether or not, residents articulate their concerns or suggestions, planners, developers and bureaucratic officials enter community council meetings often already resolute in their planning ultimatums (Jacobs 1961; Rios 2004, p. 123).

Yet while the ever-shifting model of participatory planning has a great deal of imperfections, its general implications and intention of citizen engagement make it the preferred approach among community organizations and nonprofit collectives, such as Friends of the High Line. These nonprofit organizations serve as the intermediate bodies between residents and planners and aim to bolster residents' involvement in community decisions, as well as provide assets necessary to achieving community objectives (Hum 2010, p. 462). For example, Tarry Hum, Associate Professor of UCLA School of Public Policy and Social Research, indicates that nonprofit organizations supply resources of organizational skills and professional networks that a community may not have had access to on its own (Hum, 2010 p.462). In other words, these nonprofit community groups should ideally provide the very resources of "money, access to expertise, effective organization, and media coverage" that Fainstein proposes as being the necessary tools for truly effective citizen participation from diverse groups within the community (2000 p. 461). If such resources are available, multiple publics' diverse values stand a better chance of being lucidly conveyed, understood, and, most importantly, accounted for in finalized community projects (Hum 2010, p. 462).

However, even if such tools are provided by nonprofits there is still a chance that members of the disempowered group will be excluded by "urban elites" who often constitute nonprofit collectives (DiMaggio 1990, p. 140). Paul J. DiMaggio, a Barton Hepburn Professor for Sociology and Public Affairs at Princeton University, stated that "urban elites" can either intentionally or unintentionally marginalize the disempowered in an attempt to maintain "upper-class solidarity"(DiMaggio 1990, p. 140). Due to DiMaggio's observation of nonprofits' capacity to advance exclusion of the marginalized group, Michael Cataldi (2011), who possesses a Masters in Urban Planning from the City College of New York, has suggested that the High Line is only a public park in name, and rather than benefitting the whole public, it solely generates private capital for Friends of the High Line (p. 377), which distinctly challenges the extent to which Friends of the High Line included the West Chelsea community when planning the park.

As Cataldi suggests, Friends of the High Line and the surrounding West Chelsea community may very well be overrun by urban elites wishing to sustain and expand their upper-

class influence. For example, David Harvey, Marxist geographer, criticizes the High Line and New York City Mayor Bloomberg for transforming Manhattan into "one vast gated community for the rich" (Morenas 2012, p.21). Additionally, West Chelsea possesses a rich history of working-class people who heavily depended on blue-collar manufacturing jobs at factories, warehouses and the nearby Hudson River docks (Doyle 1984). Yet, the only reminder of the community's extensive past emanates from West Chelsea's industrial built environment of old warehouses and manufacturing warehouses.

As for West Chelsea's social landscape, it has altered vastly since the late 80s as "relative increases in socioeconomic status" initiated gentrification of the area (High Line History 2010; Doyle 1984; p. 203; Freeman 2004, p. 43). This general escalation in socioeconomic status directly resulted from the migration of former SoHo art galleries to West Chelsea where the prospect of lower rent prices and larger residential and exhibit space enticed artists affected by the infiltration of retail and commercial developments in the SoHo area (Molotch 2009, p.524).

The eventual success of New York City's new thriving art gallery district abetted West Chelsea gentrification, and consequently the New York City Department of City Planning rezoned the area to be more mixed-used rather than solely industrial (West Chelsea Zoning Proposal). The 197-A proposal (1995) and the Special West Chelsea District (2005) rezoning proposal facilitated West Chelsea's transformation from a neighborhood of industrial manufacturing uses to a community comprised of artsy, upper-class commercial and residential developments (West Chelsea Zoning Proposal). Thus urban elites possessing considerable influence and networks pervaded the West Chelsea neighborhood as more opportunity for them to exhibit their power emerged. These urban elites' inevitable influence in the nonprofit Friends of the High Line reinforces the possibility that the High Line has become not only a source of economic development, but an amplifier of upper-class status and a physical representation of the gentrification that began in the late 80s.

Methods

With this provided context and the observable occurrences of West Chelsea in the last twenty years, the implication that the neighborhood's evolving social landscape affected the manner by which Friends of the High Line employed participatory methods when planning the High Line is a logical assertion. However, in order to further analyze the extent to which this nonprofit engaged the West Chelsea community I used the method of textual analysis to develop final conclusions about Friends of the High Line's methods of participatory planning.

While there is not necessarily a single set of guidelines for reading texts in geography, critical analysis and the deconstruction of the "multiple meanings" within the various mediums of text is elucidatory to the depiction of human beings' relationships with the built environment (Hay 2000, p. 128). Such a representation of human society is the main objective of human geographers (Hay 2000, p. 124), thus I deconstructed Friends of the High Line's community engagement methods through my interpretations of various sources of public media, website sources, Hammond and David's coauthored book, *High Line: The Inside Story of New York City's Park in the Sky* (2011), and my own personal observations of the High Line. This textual analysis, descriptive study will provide an empirical basis for future innovation of the participatory planning model in order to make it applicable to already affluent and empowered communities. In addition, analyzing the example of the High Line and the Friends of the High Line serves as model to view how urban revitalization public projects in other cities can replicate

or modify their planning methods to more fully incorporate the surrounding communities during preliminary phases of construction.

Discussion

Robert Hammond and Joshua David, cofounders of the nonprofit organization, Friends of the High Line, attribute the park's success to the supporters and professionals who aided in the railway's successful transformation. In fact, they write in their coauthored book, *High Line: The Inside Story of New York City's Park in the Sky*,

> "Our lack of expertise was a key to the High Line's success. It forced us to ask other people to help us. It was these others, who rallied around us, guided us, and did the work we did not know how to do, who made the High Line possible" (2011).

Clearly, they recognized that the fruition of the vision they held for the High Line necessitated a collaboration of expertise, enthusiasm, and networks of people who shared the common goal of creating a unique, public park for the West Chelsea community. Thus, Friends of the High Line initiated community engagement by knowing how to best utilize the resources they had available to them.

Firstly, Friends of the High Line introduced community engagement methods to West Chelsea by appealing to the residents' imaginations and by then gaining their support for the project. They held an Open Ideas Competition that encouraged residents to create design concepts they wished to see implemented in the future park (Hammond & David 2011, p.53).

As such, Friends of the High Line mandated that design submissions for the Ideas Competition be entered by April 25, 2003 with specific focus addressing access and safety issues of the park (Community Input 2012). Friends of the High Line were very explicit in what they hoped to see illustrated in the designs and when the time came for review of 720 submissions, the eleven jurors chose three top winners and ten honorable mentions. These thirteen designs, in addition to about 150 others, were showcased for the public in Vanderbilt Hall at Grand Central Terminal Station from July 9 to July 23, 2003 (Weiz 2003). This exhibit only further sparked awe and excitement from the community about the potential the High Line had as a public park, which was exactly the Friends of the High Line's intended goal. Friends of the High Line believed that it was especially important to approach the design process in such a way that created a "special and unique experience [for the community] as the High Line itself" (Hammond & David 2011, p. 73).

Once widespread support from the community and political officials were solidified, Hammond and David were able to take more definitive steps toward the park's completion. Following the 2003 Open Ideas Competition, Friends of the High Line facilitated a community input meeting of about 400 participants at the Metropolitan Pavilion, an event space in West Chelsea that hosts a variety of social functions (Hammond & David 2011, p. 66). Forum participants were divided into groups of ten with a discussion facilitator being a Friends of the High Line staff member or volunteer. Distinguishing this particular community input meeting as an effective way for "everyone to be involved" (Hammond & David 2011, p. 73), Friends of the High Line allowed for the groups to talk about what they liked and disliked about the submitted design entries from the Ideas Competition. The facilitator then presented the groups' main points to the entire audience. This meeting was videotaped and watched by a note-taker who later distributed the notes to those who had attended, as well as those on the mailing list via an emailed newsletter. Specifically, notes on the October 28, 2003 community input meeting

outlined that the majority called for a design that encouraged slow-paced movement, incorporated the community's industrial past, and enhanced the neighborhood's identity and thriving economic activity. A telling quote made by a meeting attendee asserted that the High Line project should demonstrate "community-based, organic, and heterogeneous planning" process (Community Input Forum 2003, p. 8). As conveyed, in the beginning stages of the park, both residents and Friends of the High Line emphasized the significance of community engagement and of the utilization of planning methods that best served the particular essence of the West Chelsea neighborhood.

In order to fulfill this prerequisite for transparency and inclusive community planning, Friends of the High Line staff regularly emailed community residents interested in the organization's progress with confirming financial sources, design plans, and the final public-private partnership with the New York City Parks and Recreation Department (Hammond & David 2011, p. 110). Many of the newsletters provided detailed information about the topics discussed at the meetings, as well as planned fundraising events and future opportunities for community input. Although, a noble attempt to update West Chelsea community residents through these emailed newsletters, the indubitable problem arises from the prospect that not all community residents may have had access to the internet or email services. Therefore the loss of a valuable perspective of the High Line from an underrepresented sector of the community is highly probable.

In addition to this certain West Chelsea sector's unaccounted status, Friends of the High Line sometimes ignored suggestions made by the community residents who did participate in the community input forums. However, the distinction between these two circumstances is that Hammond was very candid about the nonprofit's inattention to some of the community's suggestions. For example, he stated, "We didn't always listen to the community at all. It was dialogue, and when we didn't do something the community wanted we explained why" (Beyond the High Line podcast 2011). Hammond's frankness demonstrates the honest manner in which he ultimately attempted to employ inclusive citizen planning methods and sometimes sacrifice residents concerns in order to progress in constructing the High Line. Community engagement methods and resident suggestions were incorporated to a certain degree, yet Friends of the High Line generally decided upon final actions that they deemed best served community interests and moved the process along.

As discussed earlier, appeasing all residents' suggestions is impossible within the participatory planning model, but Friends of the High Line certainly made valid efforts. Even with the possibility of deviating from participant suggestions, Friends of the High Line remained committed to including the community in the final park design. Although the landscape architecture firm James Corner Field Operations and architects Diller Scofidio + Renfo were mainly chosen as the High Line design team by Friends of the High Line and the Bloomberg administration, the Friends of the High Line exhibited four of the narrowed down designs to the public in the Center for Architecture from July 16 to August 14, 2003. During this period of time, residents were able to visit the exhibits and view the finalists' proposed designs (Four Teams Four Visions 2003). The final design team was decided by voting at City Hall.

Once the decision was made and the time came for James Corner Field Operations and Diller Scofidio + Renfro to begin designs for the park, Friends of the High Line prioritized taking the design team into the community routinely (Hammond and David 2011, p. 95). Nicolai Ouroussoff, former architecture critic for *The New York Times,* praised the High Line as a community-initiated project. Specifically, he praised the final park design as a representation of

Friends of the High Line's "genuine sensitivity…to the public realm" (Ouroussoff 2004). Ourousoff commended Friends of the High Line for its concern for West Chelsea residents' values through the creation of a urban space that served the public of New York City.

Additionally, once the design team publicly presented their tentative designs, Friends of the High Line held a community input meeting on May 3, 2005 in which residents asked questions about the project. Four hundred residents attended this meeting at the Bohen Foundation in the Meat Packing District. During the meeting, residents asked questions and wrote any lingering ones they had down on a piece of paper that was later collected by Friends of the High Line.

In the following newsletter, Friends of the High Line along with insight from the design team and the City of New York, answered the community's questions with concise detail and straightforward assertions of the following steps that would be undertaken. For example, one particular question touched upon whether or not there would be a section of the High Line that would remain untouched in order to celebrate its "rusty and ruined" beauty (Question & Answer Session 2005, p.4). The newsletter precisely explained that structural remediation and restoration would be necessary in order to allow for pedestrians to safely walk on it, once completed. In sum, the newsletter displayed detailed responses to the residents' questions and provided logical explanations as to why the design team proposed the plans that they did. The design team's meeting with the West Chelsea community is another example in which Friends of the High Line exemplified community engagement methods during the design process of the park.

Another example of Friends of the High Line's commitment to engaging the West Chelsea community is their call for someone to fulfill the position of Community Engagement Manager. This job title was featured in the March 12, 2004 newsletter. Friends of the High Line explicated that one of the main responsibilities of the position was to serve as the principle liaison between the design team and the overseeing committee consisting of Friends of the High Line and representatives of the City of New York. Additionally, the position was described as necessitating a coordination of community input meetings with the design team and community representatives. Seeking such an employee who was expected to fulfill these duties, demonstrates Friends of the High Line's dedication and value of nurturing and engaging the existing West Chelsea community into the High Line project (E-Mail Newsletter 2004).

Conclusion

In summation, the above discussion conveys that Friends of the High Line implemented participatory planning methods that facilitated involvement from the West Chelsea community and fostered a community-driven public park installment. Their primary use of community input forums and emailed newsletters to West Chelsea residents demonstrate the nonprofit organization's efforts of incorporating citizen perspective in the planning phases of the public park the High Line. Friends of the High Line and, specifically, Robert Hammond and Joshua David executed a visionary urban design project with tremendous focus paid to the West Chelsea community and its residents. However, implications that the High Line may be a physical representation of the urban elite that currently exist in the West Chelsea neighborhood and the Friends of the High Line remains a convincing possibility.

Although created as a public space meant to engage the entire community, the High Line is a product of the collaborative efforts of an already affluent community steeped in favorable resources. Friends of the High Line cleverly mobilized these preexisting resources; they did not

necessarily provide them to a disempowered community. Therefore transforming the long-abandoned High Line into a sleek new public park was a relatively seamless process for Friends of the High Line, as they did not spend time supplying resources to a community, rather they skipped that step to simply enact their objectives with assets they already had available to them.

While Friends of the High Line's intentions were noble and seemingly authentic, the finished High Line and its transformative effect on both the physical and social landscape of the neighborhood demand further questioning and analysis. A neighborhood that had already been greatly impacted by sweeping gentrification since the late 80s may have experienced an increase in gentrification since the installment of the High Line, as the area is overrun by new real-estate developments of high-end condominiums, hotels, and loft conversions in expensive new residential spaces.

Additionally, the High Line remains an indicator of the strong and indelible industrial past of New York City, but the urban elites who reside in the neighborhood may have amplified the marginalization of the working-class population still residing in the West Chelsea neighborhood. Such conclusions are strictly based off of my interpretations of the Friends of the High Line cofounders Robert Hammond and Joshua David's coauthored book *High Line: The Inside Story of New York City's Park in the Sky* (2011), in which their assessment of the park since its inception conveys that they had sufficient help from people possessing funding assets, expertise and knowledge, and advantageous connections with high-status individuals in society.

Although the two former West Chelsea residents, Hammond and David, initiated the High Line project and maintained it as a community-based undertaking, this particular urban planning project directly challenges how urban planners and urban designers need to think about applying the participatory planning model to affluent communities, or in other words, communities already robust in resources. While their methods of including the affluent sectors of the community may facilitate genuine citizen participation, the potential of exclusion of the working-class population is unquestionable.

Since the most basic definition of participatory planning advocates for the involvement of everyday, ordinary people within the planning decisions of their community, empowering the often marginalized sections of a neighborhood is generally associated with its essential definition. Therefore this generally presumed delineation of participatory planning has resulted in inadequate research devoted to effective application of participatory planning methods to affluent and gentrified neighborhoods. Innovating this method of urban planning in such a way that allows for collaboration with both the affluent people of a community as well as the disempowered could allow for more genuine participatory urban planning projects in neighborhoods with similar evolving social landscapes and built environments to that of West Chelsea, New York City.

References.

Arnstein, S. R. (1969). A Ladder of Citizen Participation. *Journal of the American Planning Association*, 35(4), 216-224. Retrieved from http://lithgow-schmidt.dk/sherry-arnstein/ladder-of-citizen-participation.html

Bourne, M. (2012). The High Line: New York's Monument to Gentrification. *The Millions.* Retrieved from http://www.themillions.com/2012/06/the-high-line-new-yorks-monument-to-gentrification.html

Brooks, Galin. (2010). Reusing and Repurposing New York City's Infrastructure: Case Studies of Reused Transportation Infrastructure. Working paper, New York University.

Cataldi, M., Kelley, D., Kuzmich, H., Maier-Rothe, J., & Tang, J. (2011). Residues of a Dream World: The High Line 2011. *Theory, Culture, & Society*. 28(7-8), 358-89. doi: 10.1177/0263276411425834.

Checkoway, B. (1994). Paul Davidoff and Advocacy Planning in Retrospect. *Journal of the American Planning Association,* 60(2), 139-143. doi: 10.1080/01944369408975562

Community Input. (2012) *High Line.* Retrieved July 10, 2012 from http://www.thehighline.org/-design/community-input

David, J., & Hammond, R. (2011). *High Line: The Inside Story of New York City's Park in the Sky.* New York, NY: Farrar, Straus and Giroux.

David, J. (2002). Reclaiming the High Line. *Design Trust for Public Space*. Retrieved from http://www.designtrust.org/projects/project_01highline.html

Day, D. (1997). "Citizen Participation in the Planning Process: An Essentially Contested Concept?" *Journal of Planning Literature*, 11(3), 421-434. doi: 10.1177/088541229701100309

Deere, J. (2001). Friends Work to Save High Line Structure. *Architectural Record*. Retrieved from. http://www.lexisnexis.com/hottopics/-lnacademic/?verb=sr&csi=8399&sr=HLEAD%28Friends+work+to+save+High+Line+structure%29+and+date+is+February,%202001

DiMaggio, P. J. (1990). The Sociology of Nonprofit Organizations and Sectors. *Annual Review of Sociology,* 16, 137-159. doi: 10.1146/annurev.so.16.080190.001033

Doyle, J. (1984). Chelsea History Day. *Radical History Review,* 1984(28-30), 203-205. doi: 10.1215/01636545-1984-28-30-203

Fainstein, S. S. (2000). New Directions in Planning Theory. *Urban Affairs Review,* 35(4), 451-478. doi: 10.1177/107808740003500401

Fainstein, S.S. & Fainstein, N.I. Neighborhood Enfranchisement and Urban Redevelopment. *Journal of Planning Education and Research*. doi: 10.1177/0739456X8200200104

Four Teams Four Visions: Design Approaches to the High Line Mast Plan. In *High Line.* Retrieved July 12, 2012 from http://thehighline.org/newsletters/062504.html

Friedman, J. (2011). *Insurgencies: Essays in Planning Theory*. New York: NY: Routledge.

Friends of the High Line. In *High Line.* Retrieved June 15, 2012 from http://www.thehighline.org/about/friends-of-the-high-line/

Freeman, L., & Braconi, F. (2004). Gentrification and Displacement: New York City in the 1990s. *Journal of the American Planning Association*, 70(1), 39-52.

Goldberger, P. (2012 April). Miracle Above Manhattan. *National Geographic.* Retrieved from http://ngm.nationalgeographic.com/2011/04/ny-high-line/goldberger-text

Goodsell, A. (2012, May 7). Civilizing the Neighborhood: The High Line Park Creates Economic, Social, and Environmental Value." Retrieved from http://catalystsdr.com/2012/05/-civilizing-the-neighborhood-the-highline-park-creates-economic-social-and-environmental-value/

Grant. J. (1994). *The Drama of Democracy: Contention and Dispute in Community Planning.* Toronto, Canada: University of Toronto Press.

Hall, P. (2002). *Cities of Tomorrow*. UK: Blackwell Publishing

Hay, Iain. (2000). *Qualitative Research Methods in Human Geography*. Victoria, Australia: Oxford University.

High Line Community Input Forum. In *High Line.* Retrieved July 10, 2012 from http://www.thehighline.org/pdf/input-forum-101904.pdf

High Line Design-in-Progress Presentation Public Question-and- Answer Session. In *High Line*. Retrieved July 10, 2012 from http://www.thehighline.org/pdf/input-forum-050305.pdf

High Line History. In *High Line.* Retrieved June 15, 2012 from http://www.thehighline.org/-about/high-line-history

Hum, T. (2010) Planning in Neighborhoods with Multiple Publics: Opportunities and Challenges for Community-Based Nonprofit Organizations. *Journal of Planning Education and Research*, 29,461-71. doi: 10.1177/0739456X10368700.

Innes, J. (1995). Planning Theory's Emerging Paradigm: Communicative Action and Interactive Practice. *Journal of Planning Education and Research,* 14(3), 183-189. doi: 10.1177/0739456X9501400307

Jane Jacobs Medal. In *The Rockefeller Foundation.* Retrieved July 1, 2012, from http://www.rockefellerfoundation.org/what-we-do/where-we-work/new-york-city/jane-jacobs-medal/

Jacobs, J. (1961). *The Death and Life of Great American Cities*. New York, NY: Random House.

Kilgannon, C. (2012, December 20). In High Line's Next Section, Rare Vistas and Wild Quirks." *The New York Times*. Retrieved from. http://www.lexisnexis.com/hottopics/lnacademic/-?verb=sr&csi=8399&sr=HLEAD%28CITY+ROOM%3B+In+High+Line%27s+Next+Section%2C+Rare+Vistas+and+Wild+Quirks%29+and+date+is+December,%202010

Klemek, C. (2009). The Rise and Fall of New Left Urbanism. *Daedalus,* 138(2), 73-8.

Kovaleski, S.F. (2009, August 26). Success of High Line. Dual Rewards for Executives. *The New York Times*. Retrieved from http://www.lexisnexis.com/hottopics/lnacademic/-?verb=sr&csi=8399&sr=HLEAD%28With+Success+Of+High+Line%2C+Dual+Rewards+For+Executive%29+and+date+is+August,%202009

March 12, 2004 E-Mail Newsletter. In *High Line*. Retrieved July 11, 2012 from http://www.thehighline.org/newsletters/031204.html

Molotch, H. & Treskon, M. (2009). Changing Art: SoHo, Chelsea and the Dynamic Geography of Art Galleries in New York City. *International Journal of Urban Regional Research*, 33(2), 517-541.

Morenas, L. A. (2012). Critiquing Landscape Urbanism, A View on New York's High Line," *Economic and Political Weekly,* 47, 19-22. Retrieved from http://www.indiaenvironmentportal.org.in/feature-article/critiquing-landscape-urbanism-view-new-york%E2%80%99s-high-line

Ouroussoff, Nicolai. (2004, August 12). An Appraisal; Gardens in the Air Where the Rail Once Ran. *The New York Times.* http://www.nytimes.com/2004/08/12/arts/an-appraisal-gardens-in-the-air-where-the-rail-once-ran.html?pagewanted=all&src=pm

Paden, R. (2003). Marxism, Utopianism, and Modern Urban Planning. *Utopian Studies,* 14(1), 82-111. Retrieved from http://www.jstor.org/stable/10.2307/20718548

Rios, M. (2004). Multiple Publics, Urban Design and the Right to the City Assessing Participation in the Plaza de Colibrí.

Roos, J. P. (1974). Theoretical Problems of Democratic Planning. *Acta Sociologica,* 17(3), 217-235. Retrieved from http://www.jstor.org/stable/4194010

Smith, D. (2009). Participatory Planning and Procedural Protections: The Case for Deeper Public Participation in Urban Redevelopment. *St. Louis University Public Law Review,* 29(1), 243-272.

Sternbergh, A. (2007, April 29). The High Line: It Brings Good Things to Life. *NY Magazine.* Retrieved from http://nymag.com/news/features/31273/

Tatlor, K. (2010, July 20). High Line Founders to Get Jane Jacobs Medal. *The New York Times.* Retrieved from http://query.nytimes.com/gst/-fullpage.html?res=9F05E3DF123EF933A15754C0A9669D8B63&ref=janejacobs

"The New York High Line: Is It a Model for the City or Not?" *Beyond the High Line.* CUNY Radio. New York. 24 Jan. 2011. Podcast. http://www1.cuny.edu/mu/-podcasts/2011/01/24/beyond-the-high-line/

Yinon-Amoyal, Einat & Rachel Kallus. (2005). The neighborhood council: Where 'top-down' engages with 'bottom-up. *Geojournal*, 64(2), 91-104. Retrieved from http://www.jstor.org/stable/10.2307/41147989

Weiz, C. (2003, July 17). Designing the High Line: Competition Insights and Results. *ArchNEWS.com.* Retrieved from http://www.archnewsnow.com/features/Feature113.htm

West Chelsea Zoning Proposal. In *New York City Department of City Planning.* Retrieved July 27, 2012 from http://www.nyc.gov/html/dcp/html/westchelsea/westchelsea2a.shtml

Zukin, S. (2006). Jane Jacobs: The Struggle Continues. *City and Community*, 5(3), 223-226. doi: 10.1111/j.1540-6040.2006.00176.x

Total sexual selection on men's voices

Jason N. Bundy, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
David A. Puts, Ph. D
Assistant Professor of Anthropology
Department of Anthropology
The College of Liberal Arts
The Pennsylvania State University

Abstract

Previous correlational research indicates sexual selection in the evolution of vocal masculinity. There is a lack of experimental research on pitch variation when compared to two other sexually dimorphic vocal parameters- pitch and formant structure. We experimentally manipulated male pitch variation. Pitch variation is quadratically related to perceptions of attractiveness and dominance. We report a larger body of correlational research examining the relationships between pitch, pitch variation, and formant position with both attractiveness to women and dominance to men in naturally occurring speech. Pitch is linearly and formant position is quadratically related to attractiveness. Pitch and formant position linearly predict dominance. Pitch variation does not predict sexual selection relative to pitch and formant position.

Introduction

The human voice is well-suited to study the relative contributions of mate choice and contest competition mechanisms of sexual selection. The human voice shows large sexual dimorphism (differences between men and women) - as it relates to the vocal parameters of pitch (fundamental frequency or F0), formant position (timbre), and within-utterance standard deviation of pitch (F0-SD)(see (D.A. Puts, Apicella, & Cardenas, 2011) for F0-SD dimorphism)(Hodges-Simeon, Gaulin, & Puts, 2010a). Mating success is associated with vocal characteristics(Hodges-Simeon et al., 2010a). A 2005 paper, demonstrated within a North American sample that men with lower voice pitch self-reported more sexual partners in the last year (David A. Puts, 2005). In the Hadza, men with lower voice pitch reported a higher number of surviving offspring (Apicella, Feinberg, & Marlowe, 2007).

Voice traits are implicated in both mate choice and contest competition (Hodges-Simeon et al., 2010a). Male mate choice was probably central in women's mating competition, especially since ancestral females could not constrain the choices of larger and more aggressive males (David A. Puts, 2010).Therefore, female voices have been

primarily shaped by male preferences (D.A. Puts, Barndt, Wlling, Dawood, & Burriss, 2011).

By contrast, intrasexual competition may have been a more salient factor in the evolution of male vocal traits (David A. Puts, 2010). For instance, in a 2011 paper, dominant linguistic content predicted mating success, however, attractive linguistic content did not (Hodges-Simeon et al., 2010a). Men's traits are better designed for contest competition than for other mechanisms of sexual selection and contest competition overrides other mechanisms of sexual selection (David A. Puts, 2010). If men can exclude competitors from mating opportunities by force or threat of force, there is no opportunity for other mechanisms, such as mate choice, to occur.

While mate choice and contest competition usually favor the evolution of different traits, over the course of human evolution male monopolization of females was imperfect. This allowed other mechanisms, such as female mate choice to also contribute in shaping men's traits (David A. Puts, 2010). This may explain why many male traits that seemed designed for combat such as strength and muscularity are also favored by women (Hodges-Simeon et al., 2010a). However, even when a trait is favored under both mechanisms of selection, it will typically have a greater impact on one or the other, suggesting the primary selection pressure in the evolution of that trait. For instance, masculine musculature, voice, and facial features have a greater impact on contest competition (as measured by perceptions of dominance by other men) than mate choice (as measured by perceptions of attractiveness to women)(David A. Puts, 2010).

Both sexes seem to attend to vocal cues to assess the threat potential of intrasexual competitors (see (D.A. Puts, Barndt, et al., 2011) for women, and (D.A. Puts, Apicella, et al., 2011) for men). However, when it comes to vocal masculinity in particular, men and women may pay more attention to different vocal parameters. When judging men's attractiveness, women attend strongly to mean F0, whereas when assessing men's dominance, men attend strongly to pitch variation (F0-SD) (Hodges-Simeon et al., 2010a).

Assessing Sexual Selection in Humans

To understand the influence of sexual selection researchers look to determine how various traits influence reproductive success. One way to quantify reproductive success is to measure the number of viable offspring left behind by an individual. However, modern social conventions such as birth control and socially imposed monogamy make it difficult to interpret reproductive outcomes from an evolutionary perspective in industrialized, modern societies.

Because of this difficulty, researchers use measures of copulatory success, such as the number of sexual partners in the last year, as a proxy to reproductive success. This type of research assumes that over the course of human evolution increased access to mating opportunities has been significantly correlated with more traditional measures of reproductive success. This approach has “yielded many insights into the force of sexual selection in humans”(Hodges-Simeon et al., 2010a).

Researchers have used measures of copulatory success to assess the relative contributions of the two most salient mechanisms by which humans compete for mates of the opposite sex: intersexual mate choice and intrasexual contest competition. While both of these mechanisms have played a role over the course of human evolution, they will often favor the evolution of different types of traits.

Traits that are involved in intrasexual (typically male) contest competition are weapon-like, increasing reproductive success by allowing their bearers to use force or threat of force to exclude same-sex competitors from mating opportunities. Traits that are involved in intersexual

mate choice are charms or ornaments, increasing the reproductive success of their bearers by making them more attractive to members of opposite sex. (David A. Puts, 2010).

Examples of these two different selection pressures are found throughout nature. The hallmark example of mate choice selection is the peacock's tail feather. While a large, symmetrical, and brightly colored tail feather will not aid the peacock in survival (ecological fitness), it signals heritable genetic quality (reproductive fitness) to peahens that have developed a preference for this trait. Contest competition favors the production of size, strength, armaments, and aggression. A classic example of this intrasexual selection can be found in elephant seals, in which a dominant alpha male will attempt to monopolize an entire beachhead of females, using intimidation and/or force to ward off the advances of other males. Which mechanism is the source of the greatest selection pressure will vary between species and often between sexes within a species.

In humans, men's copulatory success can often be predicted by measuring traits involved in male contests and female choice (Hodges-Simeon et al., 2010a). Traits that make men more attractive to women, such as a lowered voice pitch are associated with variance in the number of sexual partners a man has (David A. Puts, Gaulin, & Verdolini, 2006) and the number of viable offspring sired (Apicella et al., 2007). Traits that are associated with status in male hierarchies can also predict increased mating success.

Recently, research has looked to evaluate the relative contributions of these two types of sexual selection to the evolution of human vocal parameters. Perceptions of dominance and attractiveness are used by researchers to assess which mode of sexual selection was predominant in the evolution of sexually dimorphic traits (traits that differ between males and females of the same species). Some traits are perceived as primarily as attractive to the opposite sex, suggesting that the trait evolved primarily through mate choice. However, other traits have a greater effect on how dominant its possessor is perceived to be by same-sex competitors, conveying the prominence of contest competition in the evolution of the trait.

Temporal mating strategies and male hierarchies

Sexual strategies theory has provided critical evidence demonstrating that mate preferences differ in predictable ways depending on a temporal context(Buss & Schmitt, 1993). These differences "seem tailored to solving particular adaptive problems" that are faced in long-term and short-term circumstances (Buss & Schmitt, 1993). For this reason it is important to distinguish between how monotonicity influences short-term attractiveness as compared to long-term attractiveness as it relates to intersexual selection (mate choice).

Researchers have also differentiated two distinct types of male superiority (Johnson, Burk, & Kirkpatrick, 2007).Men who are physically dominant achieve access to mates and resources through aggression or threats of aggression(David A. Puts et al., 2006). Prestige, however, is freely conferred deference that may be a mechanism for enhancing the benefits of cultural transmission (Henrich & Gil-White, 2001). It is therefore essential to assess how pitch variation differentially influences perceptions of physical dominance and prestige attributions made by other men.

In a 2011 study, F0 variation significantly predicted copulatory success. In that study fundamental frequency or voice pitch, a well-studied trait correlated with attractiveness

(and thus implicating mate choice selection) did not. This suggests the primacy of contest competition in the evolution of male vocal masculinity (Hodges-Simeon et al., 2010a)This was the first study to show that F0 variation was associated with mating success (Hodges-Simeon et al., 2010a).

F0 variation has been significantly correlated with self-reported physical aggressiveness, again suggesting its salience in assessing threat potential, a perception relevant to dominance attributions (D.A. Puts, Apicella, et al., 2011)In another study, F0 variation predicted ratings of attractiveness by non-fertile females rating short term attractiveness, fertile females rating long term attractiveness, and ratings of physical dominance by men (Hodges-Simeon, Gaulin, & Puts, 2010b).

Few studies on sexual selection and pitch variation have been experimental (Riding, Lonsdale, & Brown, 2006). Previous research has demonstrated a relationship between F0 variation and perceptions relevant to sexual selection. In the first study an experiment was conducted, manipulating only pitch variation to test how five different levels of pitch variation effect perceptions of attractiveness and dominance.

The second study was conducted to examine the influence of pitch variation on sexual selection relative to pitch and formant position in naturally occurring speech. Total sexual selection on male voices was examined through the relationships between three vocal parameters associated with variance in mating success: pitch, pitch variation, and formants and relative sexual selection were examined. Previous correlational research looking at multiple acoustic parameters in men and perceptions relevant to sexual selection have typically not included pitch variation, not examined perceptions relevant to contest competition (i.e. dominance), and have not looked for quadratic relationships (Collins, 2000).

Study 1

Methods

Voice Recording, Analysis, and Manipulation

Six male undergraduates from Michigan State University were recorded reading the first sentence of the “Rainbow Passage,” a passage used commonly in phonetics research. The rainbow passage includes many sounds from the English language and their combinations (Fairbanks, 1960). Participants read, “When the sunlight strikes raindrops in the air, they act as a prism and form a rainbow,” in an anechoic, soundproof booth using a Shure SM58 vocal cardioid microphone. A curved wire projection from the microphone stand kept each participant’s mouth approximately 9.5 cm from the microphone. Voices were recorded into a computer using Goldwave software. Recordings were made in mono at a sampling rate of 44,100 Hz and 16-bit quantization. All files were saved as uncompressed “.wav” files.

Each recording was analyzed using Praat software (version 5.2.27). Praat determines pitch using acoustic periodicity detection on the basis of autocorrelation, the correlating of a time-domain signal with itself (Boersma & Weenik, 2011). This technique is more accurate, noise-resistant, and robust, than alternative methods such as those based on cepstrum or combs (Boersma & Weenik, 2011). A pitch floor of 75 Hz and a pitch ceiling of 300 Hz were used in accordance with the programmers’ recommendations (Boersma & Weenik, 2011) for male

voices. All frequency (F0) and frequency variation (F0SD) values were converted from Hz (cycles per second) to ERB (equivalent rectangular bandwidth). The greater linearity between ERB and psychosocial auditory perception allows for a much more uniform manipulation across voice recordings from different speakers.

Using a Praat script mean F0 (mean pitch) is used in the formula meanPitch + ((x - meanPitch) * w) to manipulate each file, where x is the F0 of each point in the accompanying pitch tier, and w is the amount of manipulation to F0-SD (intonation factor) across the utterance. W values >1 result in more dynamic or less monotone voices. W values between 0 and 1 result in more monotone voices. Each voice was manipulated in Praat by increasing and decreasing the F0-SD of each voice stimulus by both one and two within-sex standard deviations in this variable.

Raters

One hundred sixty-five adults (n=165) participated in this Institutional Review Board approved study over the course of two trials. Male and female undergraduates between the ages of 18 and 25 (mean age= 20.38 years, range=18-26, SD= 1.261) from the Pennsylvania State University were recruited for the study. The sample includes eighty females and twenty-four males (n=104). A second round of data collection was conducted between April 16, 2012 and April 20, 2012. That sample includes forty-two females and nineteen males (n=61). The second trial was conducted to increase the number of participants as well as to determine the influence of upgraded headphones. Overall, voices were rated by one-hundred twenty-two females and forty-three males. Raters identified as 72.7 percent white, 9.7 percent Black or African American, 8.5 percent Asian, 4.8 percent Hispanic or Latino, 3.6 percent other, and 0.6 percent (1 rater) American Indian or Alaska Native. 93.3 percent of raters self-identified as heterosexual based on the attraction element of a demographic survey (i.e. responded that they are exclusively attracted to the other sex or almost exclusively attracted to the opposite sex).

Participants for the first trial were recruited from large lecture classes in anthropology and psychology. Participants received extra-credit compensation. Participants were scheduled for half-hour sessions.

All participants completed a demographic survey which included an item related to sexual orientation. Women were also asked to complete a menstrual cycle survey. Research has demonstrated cyclic variation in women's preferences for masculine voices (David Andrew Puts, 2006). For instance, Puts found that predicted progesterone and prolactin levels predicted preferences for vocal masculinity in normally cycling women (those not using a hormonal contraceptive).

Menstrual cycle information was used to estimate risk of conception at the time of the trial. First, the distance from the mid-cycle peak in days was calculated (e.g., -3 signifies 3 days before, 3 signifies 3 days after). This calculation was made by first estimating the onset of the participant's next menstrual bleeding. This estimate is based on the participant's self-reported last day of menstrual bleeding and self-reported average cycle length. Ovulation status was then determined by assuming that the Luteinizing hormone peak associated with ovulation occurs 15 days prior to the onset of menses (Bakos, Lundkvist, Wide, & Bergh, 1994). The distance from the mid-cycle peak (representing the number of days away from ovulation) is rounded to the nearest day. A corresponding conception risk

is assigned based on weighted averages (based on sample size) of data from Schwartz et al. (1980), Wilcox et al. (1980), and Columbo and Masarotto (2000)(D. Puts, personal communication, June 12, 2012).

Procedure

Participants sat at an isolated computer station and wore headphones (Sony MDR-V250 headphones for the first trial and Sennheisser HD 280, 64 ohm headphones for the second trial) during the experiment. Each rater listened to four manipulations and one original sample from six different voices, for a total of 30 samples per trial. Samples were presented one at a time via SuperLab stimuli presentation software. The order of stimuli presentation was randomized. After listening to each sample the participant was asked to rate the voice on a ten button Likert scale with only the ends labeled. The same ten button Likert design was used for all rating tasks. Men were asked to rate each voice for physical dominance on a scale from not dominant at all to extremely dominant. Men were also asked to rate each voice for prestige on a scale from no prestige to extremely high prestige. Women were asked after each voice to assign a rating for attractiveness in a short-term mating context on a scale from not attractive at all to extremely attractive. Women were also asked to rate each voice for long-term mating desirability on a scale from not attractive at all to extremely attractive.

Each participant listened to each voice and rated it on one perception and then repeated the trial for the other perception. Male raters were randomly assigned to either the physical dominance question asked first group or the prestige question asked first group. Likewise, women were randomly assigned to either the short-term mating question first or long-term mating question first group.

Defining short-term attractiveness, long-term attractiveness, dominance, and prestige

A definition of the dependent variable was presented with each rating task. Short-term attractiveness was defined as attractiveness for a “short-term, purely sexual relationship such as a one night stand”. Long term attractiveness was defined as desirability for a “long-term, committed relationship such as steady dating or marriage.”

Definitions were also provided to male participants with each rating. Physical dominance was defined as “capability of winning physical contests, such as sports and physical fights”. Prestige, the most nuanced of thee perceptions was defined by explaining that someone high in prestige “is respected, admired, and held in high esteem. People consider him an expert, talented and likely to be successful in some areas, value his opinion and want to be like him”. This definition represents all of the variables that loaded onto the prestige principal component in a 2009 study (Cheng, Tracy, & Henrich, 2010).

Data analysis

To examine the effect of the manipulations, while controlling for variability in ratings due to differences between the voices, the difference in rating from the unmanipulated stimuli rating was calculated for each participant’s rating of each manipulation of each voice.

Manipulations generally made the voices sound less attractive, dominant, or prestigious. The slightly less monotone manipulation was more prestigious than the unmanipulated, and the

slightly less monotone manipulation was less attractive for raters rating for long-term attractiveness. This tendency creates a convex, parabolic relationship between pitch variation and all four attributes. (Figure A.)

Multivariate analysis of variance was conducted to test for significant effects of pitch variation on mean differences in the attributes physical dominance and prestige for male raters. A separate multivariate analysis was conducted to test for significant effects of pitch variation on mean differences in the attributes short-term attractiveness and long-term attractiveness for female raters. In the presence of a significant variance, tests of between subject effects are reported along with multiple comparisons performed using the Bonferroni procedure at the $\alpha = 0.05$ significance level.

To further characterize the influence of pitch variation on selection, curve estimation was performed.

All data analyses were performed in IBM SPSS version 20.

Results

Multivariate analysis of variance (MANOVA) revealed a significant effect of pitch variation on mean difference in perceptions related to male-male competition (i.e. physical dominance and prestige) (Pillai's Trace (8,2570)=0.031, F=5.058, p=<0.001). Levene's test suggested unequal variances for physical dominance (F(4,1285)=79.445, p=<0.001) and prestige (F(4,1285)=84.667, p=<0.001). However, analysis of variance (ANOVA) is robust against unequal variances considering the equality of sample sizes. So, ANOVAs are reported with an α=0.025. Tests of between-subjects effects reveal a significant effect of pitch variation on both physical dominance (F(4)=5.097, p=<0.001) and prestige (F(4)=4.940, p=0.001). Multiple comparisons using the Bonferroni method can be found in Appendix A1.

An independent MANOVA analysis revealed a significant effect of pitch variation on mean difference in perceptions related to female mate choice (i.e. short-term and long-term attractiveness)(Pillai's Trace(8,7310)=0.028, F=12.750, p=<0.001). Levene's test suggested unequal variances for short-term attractiveness (F(4,3655)=214.926, p=<0.001) and long-term attractiveness (F(4,3655)=198.341, p=<0.001). ANOVAs are reported with an α=0.025. Tests of between-subjects effects reveal a significant effect of pitch variation on both short-term attractiveness (F(4)=13.431, p=<0.001) and long-term attractiveness (F(4)=13.584, p=<0.001). Multiple comparisons using the Bonferroni method can be found in Appendix A2.

Curve estimation revealed that pitch variation significantly predicts short-term attractiveness variance quadratically (R2=0.013, F(2,3657)=23.382, p=<0.001). The relationship can be described by the equation:

$$y = -1.272 + 0.743x - 0.117x^2$$

Curve estimation revealed that although pitch variation is linearly related to long-term attractiveness (R2=0.002, F(1,3658)=5.910, p=0.015), more variation in attractiveness is explained more significantly by the quadratic function (R2=0.014, F(2,3657)=26.795, p=<0.001). This function can be described by the equation:

$$y = -1.225 + 0.769x - 0.120x^2$$

Curve estimation revealed that pitch variation significantly predicts physical dominance variation quadratically (R2=0.014, F(2,1287)=8.861, p=<0.001). The relationship can be described by the equation:

$$y = -1.026 + 0.635x - 0.109x^2$$

Curve estimation revealed that although pitch variation is linearly related to prestige (R2=0.003, F(1,1288)=4.172, p=0.041), more variation in prestige is explained more significantly by the quadratic function (R2=0.014, F(2,1287)=9.333, p=<0.001). This function can be described by the equation:

$$y = -1.114 + 0.697x - 0.105x^2$$

Study 2

Methods

Participants

One-hundred seventy-five self-identified heterosexual Michigan State University undergraduate male students (mean age= 20.9 years, range=18-26, SD= 1.725) participated in this IRB-approved study. Participants identified as 90.3 percent White, 3.4 percent Asian, 2.3 percent Black or African American, 2.3 percent Hispanic or Latino, 0.6 percent American Indian or Alaska Native, and 1.1 percent other.

Voice recording and measurements

Men scheduled one, one-hour morning session (starting times between 8:20 and 10:00 h) and one, one-hour evening session (starting times between 17:20 and 19:00 h). There was a week in between sessions. Voice recordings were made at each session.

Male participants were recorded reading an excerpt of the rainbow passage, a standard passage used in phonetics research (Fairbanks, 1960). Participants were recorded in an anechoic, soundproof booth using a Shure SM58 carioid dynamic microphone. A curved wire projection was used to keep participants' mouths approximately 9.5 cm from the capsule of the microphone. Voices were digitally recorded using Goldwave software. Mono, uncompressed wav audio files with a sampling rate of 44,100 Hz and 16 bit quantization were created for all voices.

Each recording (duration mean (SD) = 5.33 (0.69) seconds) was analyzed using Praat, a free software program for doing phonetics research on computers. Each recording was measured for pitch or fundamental frequency (F0)(mean(SD)= 112.52(14.61) Hz), pitch variation or monotonicity (F0SD)(mean (SD)=15.87(4.49)Hz), and four formant frequencies (F1- F4)(mean (SD)= 444.23(30.12)Hz for F1, 1512.60(64.50)Hz for F2, 2397.47(82.95)Hz for F3, & 3,388.57(113.71)Hz for F4). A pitch floor of 75 Hz and a pitch ceiling of 500 Hz were used in accordance with the programmer's recommendation for male voices (Boersma & Weenik, 2011). Default settings were used for all other program parameters.

Formants, F1 through F4 were measured at each glottal pulse (automatically detected by Praat) and averaged across measurements. This calculated formant measurements for the entire utterance- sampling a greater range of vocal tract configurations when compared with only measuring individual vowels. This method only measures voiced speech. It avoids fricatives, which regress apparent vocal tract length because the fricative originates in oral turbulence, not vocal fold vibration (Baken, 1987).

Praat sometimes shifts formants (e.g. calculating F2 as F1). Because of this tendency, formant measurements from glottal pulses for which any value exceeded a predetermined threshold (less than 2% of pulses) were omitted. Published data was used to determine thresholds for formant measurements (Rendall, Kolias, Ney, & Lloyd, 2005). Thresholds for men were 1000, 2850, 2750 and 4500 Hz for F1-F4.

All measurements were then converted from cycles per second (Hz) to equivalent-rectangular bandwidths (ERB). The greater linearity between ERB measurements and auditory perception allows for a more meaningful interpretation of data throughout the range of human vocal parameters. To convert from Hz to ERB we used the formula described by Glasberg and Moore (Glasberg & Moore, 1990),

$ERB = 21.4 * \log(0.00437 * Fc + 1)$, where Fc is frequency in Hz.

Formant position (Pf) was then calculated. Formant position was defined as the standardized between session mean of standardized formant values for the first n formants, where formants are standardized using between-sex means and standard deviations. Thus,

$$P_{\mathrm{f}} = \frac{\sum_{i=1}^{n} F'_i}{n}$$

, where F'_i the standardized *i*th formant, and *n* is the number of formants measured. Essentially, this method assigned each standardized formant a unit weight rather than, for example, a beta weight obtained via regressing formants on sex or height. This approach was used following Cohen (Cohen, 1990).Cohen suggested that unit weights have better predictive power than beta weights derived from moderate-sized samples.

Pitch (F0) and pitch variation (F0SD) were also averaged together for both sessions to create composite measures of pitch and pitch variation (referred to in the analysis simply as pitch and variation). Data from one session was used in lieu of means for participants who only had one session of data. Twenty-three participants had only first session ratings. One of these participants does have second session measurements averaged into pitch and variation. Three participants had only second session voice measurements and ratings. One participant had only first session ratings but was not rated for dominance. Therefore, there is one less mean dominance score (N= 174).

Rating procedures

Voice recordings were rated by 568 men (mean age: 19.4 ± 1.8 years) and 558 women (mean age: 19.1 ± 2.4 years) from a large northeast U.S. University. Each rater assessed 24.9 ± 2.6 voice recordings. Raters listened to the voices in this sample as well as the voices of male siblings and female participants not included in this sample. No rater assessed a voice more than once. Using 7-point Likert scales, voices were rated for short-term and long-term attractiveness by women and physical dominance by men. The order in which the rating tasks were completed was randomized (e.g. short- or long-term first). The order of stimulus presentation was also randomized. The first fifteen ratings obtained for each voice for each type of rating were averaged to produce mean short-term attractiveness, long-term attractiveness, and physical dominance ratings.

Data analysis

Pearson's correlation was also used to examine the relationship between short-term attractiveness and long-term attractiveness to determine the feasibility of creating a composite measure, attractiveness. Pearson's correlation indicates a near perfect correlation between long-term and short-term attractiveness (r(173)=0.958, p=<0.0001). A new variable, attractiveness (i.e. mean attractiveness), was used in further analysis.

To quantify the strength and form of sexual selection regression techniques were used following the work of Hunt et al. (John Hunt, Breuker, Sadowski, & Moore, 2009). First, trait values for pitch (mean F0), variation (F0SD), and formants (Pf) were standardized, $\left[z_i = \frac{(x_i - \mu_i)}{\sigma_i} \right]$. Then selection (i.e. attractiveness and dominance) was converted to relative selection (ω) by dividing individual selection by mean selection for the population, $\left(\omega = \frac{W}{\overline{W}} \right)$.

Examination of the zero-order linear relationships between acoustic measurements (standardized trait values) and relative sexual selection (relative attractiveness and relative dominance) was performed using Pearson's correlation.

Correlations- Relative Selection and Vocal Measurements (ERB)

		Formant Position	Pitch	Variation	Relative Attractiveness	Relative Dominance
Formant Position	Pearson Correlation	1	.039	.157*	-.131	-.361**
	Sig. (2-tailed)		.610	.037	.085	.000
	N	175	175	175	175	174
Pitch	Pearson Correlation	.039	1	.541**	-.324**	-.427**
	Sig. (2-tailed)	.610		.000	.000	.000
	N	175	175	175	175	174
Variation	Pearson Correlation	.157*	.541**	1	-.187*	-.321**
	Sig. (2-tailed)	.037	.000		.013	.000
	N	175	175	175	175	174
Attractiveness	Pearson Correlation	-.131	-.324**	-.187*	1	.644**
	Sig. (2-tailed)	.085	.000	.013		.000
	N	175	175	175	175	174
Dominance	Pearson Correlation	-.361**	-.427**	-.321**	.644**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	174	174	174	174	174

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Multiple regressions were used to calculate linear selection gradients:

$$\omega = \alpha + \beta z_1 + \beta z_2 + \beta z_3 + \varepsilon$$

Alpha (α) is the regression intercept, Betas (βs) are the partial regression coefficients and epsilon (ε) is the random error component. The partial regression coefficients are the standardized linear selection gradients and estimate the contribution of a particular trait to fitness while holding the effects of the other traits constant. Beta therefore represents the direction of the greatest incline from the population average on that particular fitness surface (John Hunt et al., 2009; Lande & Arnold, 1983)

Nonlinear forms of selection are then estimated by running separate regressions that include quadratic (zii2) and cross-product ($z_i z_j$) terms:

$$\omega = \alpha + \beta z_1 + \beta z_2 + \beta z_3 + \frac{\gamma}{2} \boldsymbol{Z}_1^2 + \frac{\gamma}{2} \boldsymbol{Z}_2^2 + \frac{\gamma}{2} \boldsymbol{Z}_3^2 + \gamma z_1 z_2 + \gamma z_1 z_3 + \gamma z_2 z_3 + \varepsilon$$

The linear terms (β) are not interpreted from this equation. Instead, the equation is used with higher order terms to indicate how selection influences the variances and covariances of traits when the effects of linear selection are removed (Hunt et al., 2009 & Lande & Arnold, 1983). The γ coefficients associated with the squared terms of each standardized variable reflect the direct effects of nonlinear selection on the trait variances, characterizing the shape of curvature of the fitness surface along the individual traits axes (z1-z3) (Hunt et al., 2009 & Lande & Arnold, 1983). A negative γ indicates convex (i.e. downwardly curved) selection while a positive γ indicates concave (i.e. upwardly curved) selection. The γ coefficients for cross-products represent the direct effects of correlational selection for traits to become positively (positive γ) or negatively (negative γ) correlated (John Hunt et al., 2009).

Hunt cautions that interpretation of nonlinear selection can be troublesome as the number of individual traits being examined increases (John Hunt et al., 2009). When only a few traits show nonlinear forms of selection, the multiple-regression approach provides an adequate description and quantification (J Hunt, Wolf, & Moore, 2007). Since the current analysis only involves three traits, canonical analysis was not employed.

All data analyses were performed in IBM SPSS Statistics version 20.

Results

Pearson's correlation calculated significant correlations between formant position and variation (r(173) = 0.157, p= 0.037) and formant position and relative dominance(r(172) = -0.361, p= <0.001). The correlation between formant position and relative attractiveness neared significance (r(173) = -0.131, p= .085). There are significant correlations between pitch and variation (r(173) = 0.541, p=<0.001), pitch and relative attractiveness (r(173) =-0.324, p=<0.001), and pitch and relative dominance (r(172) = -0.427, p=<0.001). Variation is also significantly correlated with relative attractiveness (r(173) =-0.187, p=0.013) and relative dominance (r(172) =-0.321, p=<0.001). Finally, relative dominance and relative attractiveness are significantly correlated (r(172) = 0.644, p=<0.001).

A linear regression revealed that formants, variation, and pitch predict a significant proportion of the variance in attractiveness (R2=0.119, F(3,171)=7.694, p=<0.001). However, pitch was found to be the only significant linear predictor of attractiveness (β=-0.323, t(171)=-3.775, p=<0.001). A second linear regression including quadratic and interaction terms (R2=0.173, F(9,165)=3.847, p=<0.001) indicates that formant position (formant position2) is significantly, negatively, quadratically related to relative attractiveness (β=-0.175, t(165)=-2.347, p=0.02).

A linear regression revealed that formants, variation, and pitch predict a significant proportion of the variance in relative dominance ($R2=0.304$, $F(3,170)=24.735$, $p=<0.001$). Both formant position and pitch are significant linear predictors of dominance ($\beta=-0.337$, $t(170)=-5.190$, $p=<0.001$ for formant position and $\beta=-0.383$, $t(170)=-5.013$, $p=<0.001$ for pitch). A second linear regression including quadratic and interaction terms ($R2=0.584$, $F(9,164)=9.410$, $p=<0.001$) indicates that pitch (mean pitch2) is significantly, negatively, quadratically related to relative dominance ($\beta=0.176$, $t(164)=2.165$, $p=0.032$). Curve estimation revealed that although pitch is quadratically related to dominance ($R2=0.190$, $F(2,171)=20.088$, $p=<0.001$), the variation in dominance may more accurately be described as a linear function ($R2=0.182$, $F(1,172)=38.375$, $p=<0.001$). This function can be described by the equation:

\

$$y = 1.000 - 0.098$$

Discussion

Multivariate analysis of variance indicates that pitch variation has a significant effect on perceptions relevant to both mate choice and contest competition modes of sexual selection.

Curve estimation indicates that a convex quadratic function significantly describes the relationship of between pitch variation and short-term attractiveness as well as pitch variation and physical dominance. A convex quadratic function also more significantly describes the relationships between pitch variation and long-term attractiveness as well as pitch variation and prestige than a linear function.

Pitch negatively linearly predicts relative attractiveness; however formant position and pitch variation do not. This result supports current research suggesting that women may primarily use pitch as cue to vocal masculinity and judge men with lower pitched voices to be more attractive. Formants are negatively, quadratically related to relative attractiveness (convex selection). This suggests that men's voices are under stabilizing selection, such that voices near the within-sex mean in formant position are the most attractive. Pitch variation is not quadratically related to attractiveness, when controlling for the influence of pitch and formant structure.

Pitch and formant position linearly predict relative dominance; however pitch variation does not. This supports research correlating pitch with other measures of physical dominance such as height, weight, arm strength, and testosterone levels and suggests that men's voice have been influenced by selection to evolve masculine voice pitch as an indicator of threat potential. Pitch is also positively, quadratically related to relative dominance (concave selection), but the relationship is predominately linear in nature (see Relative Dominance curve fit plot)

Conclusions

Study 1 suggests that pitch variation definitely affects dominance and attractiveness perceptions curvilinearly. This result indicates that pitch variation has played a role in the perception of vocal masculinity for both men and women.

Study 2 suggests that pitch variation is not an important contributor to total sexual selection in male voices, relative to pitch and formant position in naturally-varying speech. Pitch important to attractiveness and dominance, but more important to dominance. This result that selection for low pitched voices is both intrasexual (related to contest competition) and

intersexual (related to mate choice). It also suggests a predominance (even if marginally) of contests competition in the evolution of masculine voice pitch.

Study 2 also suggests that formant position is negatively, curvilinearly related to attractiveness and negatively linearly to dominance. This result supports research correlating sexually dimorphic formant measurements (i.e. masculine vocal timbre) with attractiveness to women and indicators of physical dominance such as upper body strength, height, weight, and fighting abilities. That a linear nature describes the relationship between formant position and dominance while a quadratic relationship describes the relationship between formant position and attractiveness may suggest that masculine vocal timbre plays a role in assessing the life history and health status of conspecifics. This may help explain why men masculine vocal timbre is correlated physical dominance attributions by men, and women use it to predict age. In comparison, formant structure has a more significant influence on dominance, again suggesting the primacy of contest competition in the evolution of vocal masculinity.

The current study demonstrates that while correlational research can suggest the need to investigate a trait experimentally, experimental results need to be interpreted in the context of related traits in naturally occurring stimuli. In general, we also present evidence of stronger selection on men's voices through male contests than female choice. More research is needed, designed explicitly to answer this question. Finally, future research will also determine if selection via contests in other traits associated is directional while selection via female choice on other traits demonstrates stabilizing selection on men's traits, as this is one of the first studies to examine quadratic relationships between sexually dimorphic vocal parameters and sexual selection.

References

Apicella, C. L., Feinberg, D. R., & Marlowe, F. W. (2007). Voice pitch predicts reproductive success in male hunter-gatherers. *Biology letters*, *3*(6), 682–4. doi:10.1098/rsbl.2007.0410

Baken, R. J. (1987). *Clinical measurement of speech and voice*. Boston, MA: Little, Brown, & Co.

Bakos, O., Lundkvist, O., Wide, L., & Bergh, T. (1994). Ultrasonographical and hormonal description of the normal ovulatory menstrual cycle. *Acta Obstetricia et Gynecologica Scandinavica*, *74*(10), 790–796.

Boersma, P., & Weenik, D. (2011). Praat: Doing phonetics by computer. Retrieved from http://www.praat.org/

Buss, D. M., & Schmitt, D. P. (1993). Sexual Strategies Theory: An Evolutionary Perspective on Human Mating. *Psychological Review*, *100*(2), 204–232. Retrieved from http://www.psy.cmu.edu/~rakison/bussandschmitt.pdf

Cheng, J. T., Tracy, J. L., & Henrich, J. (2010). Pride, personality, and the evolutionary foundations of human social status. *Evolution and Human Behavior*, *31*(5), 334–347. doi:10.1016/j.evolhumbehav.2010.02.004

Cohen, J. (1990). Things I have learn (so far). *Am. Psychol.*, *45*, 1304–1312.

Collins, S. A. (2000). Men's voices and women's choices. *Animal Behaviour*, *60*(6), 773–780. Retrieved from http://www.sciencedirect.com.ezaccess.libraries.psu.edu/science/article/pii/S0003347200915239

Fairbanks, G. (1960). *Voice and Articulation Drillbook* (2nd ed.). Harper & Row.

Glasberg, B., & Moore, C. J. (1990). Derivation of auditory filter shapes from notched-noise data. *Hearing Research*, *47*(1-2), 103–138. Retrieved from http://www.sciencedirect.com.ezaccess.libraries.psu.edu/science/article/pii/037859559090170T

Henrich, J., & Gil-White, F. J. (2001). The evolution of prestige: freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. *Evolution and human behavior official journal of the Human Behavior and Evolution Society*, *22*(3), 165–196. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11384884

Hodges-Simeon, C. R., Gaulin, S. J., & Puts, D. A. (2010a). Voice Correlates of Mating Succes in Men: Examining "Contests" vs "Mate Choice" Modes of Sexual Selection". *Archives of Sexual Behavior*. doi:doi:10.1007/s10508-010-9625-0

Hodges-Simeon, C. R., Gaulin, S. J., & Puts, D. A. (2010b). Different Vocal Parameters Predict Perceptions of Dominance and Attractiveness. *Human Nature*. doi:doi:10.1007/s12110-010-9101-5

Hunt, J, Wolf, J. B., & Moore, A. J. (2007). The biology of multivariate evolution. *Journal of evolutionary biology*, *20*(1), 24–7; discussion 39–44. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17209992

Hunt, John, Breuker, C. J., Sadowski, J. A., & Moore, A. J. (2009). Male-male competition, female mate choice and their interaction: determining total sexual selection. *Journal of evolutionary biology*, *22*(1), 13–26. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19120810

Johnson, R., Burk, J., & Kirkpatrick, L. (2007). Dominance and prestige as differential predictors of aggression and testosterone levels in men.pdf (application/pdf Object). *Evolution and Human Behavior*, *28*(5), 345–351. Retrieved from http://www.neurobiologiadoestresse.ufsc.br/odival/arquivos/hormonio masculino Dominance and prestige as differential predictors of aggression and testosterone levels in men.pdf

Lande, R., & Arnold, S. J. (1983). The Measurement of Selection on Correlated Characters. *Evolution*, *37*(6), 1210–1226.

Puts, D.A., Apicella, C. L., & Cardenas, R. A. (2011). Masculine voices signal men's threat potential in forager and industrial societies. *Proceedings of the Royal Society B.*

Puts, D.A., Barndt, J. L., Wlling, L. M., Dawood, K., & Burriss, R. (2011). Intrasexual competition among women: Vocal femininity affects perceptions of attractiveness and flirtatiousness. *Personality and Individual Differences*, (50), 111–115. doi:doi:10.1016/j.paid.2010.09.011

Puts, David A. (2005). Mating context and menstrual phase affect women's preferences for male voice pitch. *Evolution and Human Behavior*, *26*(5), 388–397. Retrieved from http://www.sciencedirect.com.ezaccess.libraries.psu.edu/science/article/pii/S1090513805000176

Puts, David A. (2010). Beauty and the beast: mechanisms of sexual selection in humans. *Evolution and Human Behavior*, *31*(3), 157–175. doi:10.1016/j.evolhumbehav.2010.02.005

Puts, David A., Gaulin, S. J., & Verdolini, K. (2006). Dominance and the evolution of sexual dimorphism in human voice pitch. *Evolution and Human Behavior*. Retrieved April 27, 2012, from http://www.anth.ucsb.edu/faculty/gaulin/Puts_Gaulin_Verdolini_2006.pdf

Puts, David Andrew. (2006). Cyclic variation in women's preferences for masculine traits. *Human Nature*, *17*(1), 114–127. doi:10.1007/s12110-006-1023-x

Rendall, D., Kolias, S., Ney, C., & Lloyd, P. (2005). (F0) and formant profiles of human vowels and vowel-like baboon grunts: the role of vocalizer body size and voice-acoustic allometry. *J. Acoust. Soc. Am.*, *117*(2), 944–55.

Riding, D., Lonsdale, D., & Brown, B. (2006). The effects of average fundamental frequency and variance of fundamental frequency on male vocal attractiveness to women. *Journal of Nonverbal Behavior*, (30), 55–61.

I Want to Live Again: an Existential Analysis of It's a Wonderful Life

Joshua J. Gleim, McNair Scholar
The Penn State University

McNair Faculty Research Advisor:
Shannon Sullivan, Ph.D
Professor of Philosophy, Women's Studies, and African American Studies
Head of the Department of Philosophy
College of the Liberal Arts
The Penn State University

Abstract

This paper focuses on the existential aspects of the film *It's a Wonderful Life*. Drawing on Jean Paul Sartre's atheistic existentialist perspective, this project investigates the intersections between film and modern philosophy. The film features philosophical ideas from existentialist writings such as Friedrich Nietzsche's *Thus Spoke Zarathustra* and *The Gay Science*. Through comparative analysis, this research assesses what types of phenomena cause individuals to turn back to the same conditions that caused them to turn away.

Introduction

Every Christmas season in the past several decades, Frank Capra's classic holiday film *It's a Wonderful Life* airs on major cable television stations all over the world. Each year, many Americans watch this film and are filled with that warm 'fuzzy' feeling that is festively compared to a hot cup of cocoa during the winter months. I would suggest that this film is more than just a holiday tradition; it is a piece of fiction that has a unique interaction with philosophy, specifically existentialism. Philosophically, the plethora of questions, thought provoking ideals, and premises raise a unique puzzle to analyze. The film features conflicts such as free will vs. determinism, being human vs. being automated, as well as universal issues such as suicide, happiness, love, and so on. Since the main character in Capra's film turns back to the same conditions in life that caused his existential crisis, *It's A Wonderful Life* may serve as a useful case study for an existential analysis. Three questions guide this project. First, can this film be interpreted from an existential perspective? Secondly, what is significant about this film, existentially? Finally, why do individuals turn back to the same conditions in life that caused them to turn away?(In other words, what phenomena seem to cause humans to choose suffering over happiness?) To answer these questions, I will use primary texts of Jean-Paul Sartre, and Friedrich Nietzsche, along with some secondary literature such as *Sartre Explained: From Bad Faith to Authenticity* and *Existentialism and Contemporary Cinema: A Sartrean Perspective*. From these texts I will use specific existential ideas to analyze *It's A Wonderful Life* and then examine ideas that are present such as Sartre's anguish, forlornness, and despair along with Nietzsche's affirmation of life and the eternal recurrence I will draw on these texts' characterizations of existentialist ideas to frame my analysis of *It's A Wonderful Life*. I will be relying heavily on Sartre's atheistic approach to existentialism because he acknowledges the

relationship between artistic production and philosophy. In this case *It's a Wonderful Life* acts as a case study regarding narrative of what it means to be human and our experiences.

Existential Perspectives

Before addressing the questions posed above, a foundation of relevant concepts and ideas must be reviewed. The central term in this paper is existentialism. Many philosophers have been labeled (either self-proclaimed or by their successors) as existentialist. These individuals range from Søren Kierkegaard and Friedrich Nietzsche in the 19th century, to Jean-Paul Sartre, Maurice Merleau-Ponty, and Albert Camus in the mid 20th century and numerous others both during and after their careers including the present.

The term existentialism has had a variety of uses and meanings. Sartre in *Existentialism and Human Emotions* writes that existentialism has become so broad a meaning that it he must explicitly define what he means by existentialism, and specifically in a philosophical plane (Sartre 12). Sartre writes that existentialism is "… a doctrine which makes human life possible and, in addition, declares that every truth and every action implies a human setting and a human subjectivity." (10) For this paper I too will use this definition as my operational meaning for existentialism.

Sartre's aforementioned text *Existentialism and Human Emotions* is used as a mooring device in this paper for my approach to existentialism. The text serves this purpose well because Sartre is writing to defend existentialism and the charges against it in his contemporary setting of post World War II France (10). These charges stem from a broad collection of individuals that Sartre feels makes up the collective community of existential philosophers. He explains that there are two major distinctions within the existential philosophical community, which can be referred to as the Christian and atheistic existentialist (13). He champions the atheistic perspective of existentialism and explains/argues its superiority, and defends it against what he thinks critics argue are the shortcomings of the atheistic approach. There are several specific concepts of atheistic existentialism that are germane to this paper.

The most important concept to explain is the difference that separates the approaches to the relationship between essence and existence. Sartre builds his argument on how the different assumptions to this relationship fundamentally make these two groups incommensurable (13). Essence for this discussion can be generally formulated as being the concept or idea of a thing. For example, when an individual is asked to make or build a chair, before they begin the act of making one must first imagine and formulate the idea or concept of what a chair is. This idea is the essence of the chair they will now build. In contrast, existence is formulated as the actual 'being' of an essence (Sartre 14-15). Continuing with the same example, now that an individual has the essence of a chair, they create it and in doing so the chair is now a thing; the chair is in existence or being. The person has taken the essence and brought it into existence. Thus when creating, essence precedes existence (Sartre 14). Sartre's explanation is that for Christian existentialist the existence of humans is due to God making us. Thus in the same manner we make objects (like in the chair example), we have an idea (essence) about the thing we are going to make and then create it (existence). Hence Sartre writes that from the Christian existentialist perspective, humanity's essence precedes humanity's existence (15). From the atheistic existential perspective the inverse argument is favored. Sartre writes that atheistic existentialism, "…states that if God does not exist, there is at least one being in whom existence precedes essence, a being who exists before he can be defined by any concept, and that this being is man,

or, as Heidegger says, human reality" (15). For this paper I will using the atheistic approach to existentialism, and will adhere to the premise that human existence precedes human essence.

With atheistic existentialism Sartre explains ideas about how essence precedes existence when creation occurs. For atheistic existentialism the first principle must be the focus on subjectivity. Sartre concisely defines subjectivity as, "Man is nothing else than what he makes of himself" (15). As such, "Not only is man what he conceives himself to be, but he is also only what he wills himself to be, after this thrust toward existence" (Sartre 15). Sartre is emphasizing the point that in the atheistic perspective of existentialism, humans create and shape what the essence of humanity is with every choice, decision, and action. In doing this, "Man first of all is the being who hurls himself toward a future and who is conscious of imagining himself as being in the future"(Sartre 16). From these statements we can understand how under an atheistic existential perspective (whose first principle is subjectivity) examines how humanity shapes and creates its own understanding of its human meaning, experience, and reality presently and consciously looking towards the future. With an atheistic existential perspective creative works of fiction about human meaning and experience can be critically analyzed for the purpose of defining what humans feel and understand as the essence of human existence.

I support the idea that as humans create objects from the idea in our mind, the works of fiction act as an object that leaves one's imprint on how and what is humanity and thus allows us to fulfill our self as a human (51). Sartre uses several stories in his writing, such as his own experiences with a Jesuit priest, the experience of his student during the war, and novels such as *Around the World in Eighty Hours*. All these examples that Sartre mentions and describes may seem entirely factual but they may be utterly fictional or altered at the very least; Sartre could very well have altered the details to more clearly demonstrate what he was trying to convey. The examples he uses serve to describe and explain an idea and concept about humanity that Sartre is expressing or analyzing. Thus he demonstrates explicitly how fiction serves to reify the essence he is trying to convey regarding existentialism. He subjectively chooses how to act in this process of creating.

Film and Existentialism

I have described how fiction is both a fundamental tool for existentialism and germane to thinking existentially under Sartrean theory of atheistic existentialism. I have not answered the question of whether or not the film *It's a Wonderful Life* can be interpreted from an existential perspective. I have explained how fictional literature has been used for existential writings and thought, but not the medium of film. Thus the discussion now turns to film as a work of fiction.

The film is a creative work directed by Frank Capra and focuses on the protagonist, George Bailey. The film covers topics such as personal struggles and issues with self-meaning or worth, emotions, and the trials and tribulations of the character's life. The film focuses on George and his experiences in the film.

Film and print are entirely two different mediums, but they also have several similarities. One point may be the accessibility of film and literature in different time periods. *It's a Wonderful Life* is popular in its own right for our current western pop culture. The American Film Institute has held *It's a Wonderful Life* as a top 20 film in the last 100 years of cinema (afi.com). It has aired consistently on cable television during the Christmas season since the mid 1970s. In 1987, a Florida judge ordered a man to watch the film as part of his sentence for killing his ill wife, and then trying to kill himself. According to the judge, he wanted to show the man

the value of life. The film is still shown come Christmas time on NBC network. According to the article " 'It's a Wonderful Life' Turns 65", the 2011 TV ratings press release showed that NBC's 31st primetime telecast nabbed the network the top 18-49 rating for a non-sports Saturday night in nearly a year. The last time that happened was during the last "It's a Wonderful Life" telecast in December 2010 (tv.yahoo.com).

Film also offers a different experience for the viewer than reading a book. In an article in the *Journal of Aesthetics and Art Criticism*, the article explored the impact of Sartre's writings on Nothingness, had on Cinema. In this article the author writes about films strength in representing the tension between portraying abstract concept of Nothingness and concrete representation of things. ""No other medium can represent the physical surface of reality as meticulously as cinema and no other medium can express the potential emptiness behind that surface as strongly as cinema"(Kovacs 135). This is an ability that print seems to lack, because it can only describe reality but never portray it as it is, in the way film can with images and sound. In *Existentialism and Cinema* the point is made that Sartre himself believed that, "…film must be seen as a cultural experience on a par with Greek art or Philosophy and that, of all the art forms, it most resembles the real world" (Boulé and McCaffrey 6).

By synthesizing these two points: first that atheistic existentialism is a perspective in which human creation is a expression of what one perceives is the essence of being human, secondly that film is a medium that shows not only the specifics of a situation but also the abstract that humans experience, I find that we can indeed examine the film in an existential perspective. This claim is supported by William Pamerleau in his book *Existentialist Cinema* writes*:*

> … film, precisely because of its concrete depictions, can convey insights that inform even the abstract ideas of theoretical philosophy. Generally speaking, there are two ways in which it does so: through its ability to deliver realistic narratives and through the expressive nature of visual imagery. (85)

This film can be interpreted from Sartre's atheistic existential perspective as a way to understand humanity and human experience through George.

Sartrean Existential Concepts in the Film

The film incorporates numerous philosophical ideas, many of them existential. Nearly each scene has at least one concept, if not more, that has been discussed in major philosophical writings. Many of the philosophical ideas that will be mentioned in this paper may be independent of each other, but the ideas share such similar content that when exemplified in the film the differences become blurred. It would be difficult to describe the depth and nuances of each scene in this way, especially because an inexhaustible amount of arguments could be made in each scene on the varying number of specific philosophical ideas a scene may incorporate. For clarity's sake, I have chosen to focus on the major idea that a scene exemplifies to show the quality and depth that a scene exemplifies.

The basic plot of Capra's film begins with the audience being introduced to George Bailey, as a boy with enthusiastic and excited outlook towards life. George is sure that his life will hold a plethora of adventures and wonders to behold. Reality dawns for George though as his plans and aspirations are repeatedly setback as he is presented with obstacles.

The first of many philosophical ideas can be seen in Sartre's *Existentialism*. When George wants to leave his home of Bedford Falls early in the film, he says to Mary (who would

become his wife):

> I know what I'm going to do tomorrow and the next day and the next year and the year after that. I'm shaking the dust of this crummy little town off my feet and I'm going to see the world. Italy, Greece, the Parthenon, the Coliseum. Then I'm coming back here and go to college and see what they know . . . and then I'm going to build things. I'm gonna build air fields. I'm gonna build skyscrapers a hundred stories high. I'm gonna build bridges a mile long . . .

George's plans though are placed on hold by one obstacle after another. The obstacles begin on the night of his younger brother's graduation from high school, on the eve of his departure from home. As he shares his wishes with Mary, he is told that his father (who runs the local Building and Loan) has had a stroke. A local banker and slum lord, Mr. Potter, takes this as an opportunity to try to convince the board of directors of the Building and Loan to stop what he calls the 'sentimental hogwash' of making loans to the disadvantaged people of Bedford Falls that George's father had been instrumental in insuring for the people of Bedford Falls. When George hears of this, he rushes to protest. George persuades the board members to reject Potter's proposal; they agree, but only on the condition that George himself run the Building and Loan. So George reluctantly stays in Bedford Falls and gives the money he has saved for college, to his brother Harry.

At this point in the film what George experiences is an example of Sartrean anguish. In *Existentialism* Sartre defines it as:

> The man who involves himself and who realizes that he is not only the person he chooses to be, but also a law-maker who is, at the same time, choosing all mankind as well as himself, can not help escape the feeling of his total and deep responsibility. (18)

We can think about this as one's inescapable feeling of total and deep responsibility for directly choosing one's own, and indirectly humanity's law. This is because each act of an individual posits that they are acting in the way they feel a human being should act in this situation. Sartre uses the story of Abraham, who is still choosing what is "the law" when God demands that Abraham sacrifice his son (19). Abraham in this case is choosing not only what he will do, but what others must do in this circumstance, thus he is not only the law maker for himself but for humanity (19). This situation is very much what George is experiencing in the film. He is faced with a circumstance and choice he must make, to stay behind and run the Building and Loan as his father did, or abandon it and pursue his plans. George exhibits this anguish when he states to a member of the board who explains the condition to him, "Dr. Campbell, now let's get this thing straight. I'm leaving. I'm leaving right now. I'm going to school. This is my last chance. Uncle Billy here, he's your man." When George learns that it is his decision of whether to stay and fulfill the position or go to college that will decide the fate of the Building and Loan, he chooses to stay. The scene depicts George's reluctance to choose as he does giving ample evidence of his anguish in being totally responsible for his choice. His feelings are of total and deep responsibility that he cannot escape.

The next concept that subsequently follows in Sartre's *Existentialism* is forlornness. This

is the feeling that humans experience because they have no excuses for their choices, that we have nothing to cling to because everything is possible (in the sense that atheistic existentialists are not guided by an omnipotent God.), and that because no God exists, we are alone to make our choices (neither fate, nor divine guidance can make them for us). An example to clarify the difference between anguish and forlornness would be in the aforementioned scene when George was deciding whether to take the job or not. Sartre writes:

> God does not exist and that we have to face all the consequences of this…The existentialist, on the contrary, thinks it very distressing that God does not exist, because all possibility of finding values in a heaven of ideas disappears along with Him; there can no longer be an *a priori* Good, since there is no infinite and perfect consciousness to think it. (21-22)

Sartre uses a parable of a student he once taught. The student was faced with a major decision during WWII, he had to decide if he would join the Allies and help fight the Nazi's or if he would remain at home and take care of his aging mother. The dilemma for him being that each option had positive and negative impacts. Sartre writes how this predicament places the person in a sense of forlornness because he has nothing to seek guidance from. His religion tells him a number of justifications for each decision. Because existentialism first principle is subjectivity, there is no ultimate rule for him to seek guidance in. He is forlorn because nothing and no one can help him choose (24-29).

This idea is shown in a subsequent scene when there comes a 'run' on the Building and Loan, just as George and Mary are about to go on their honeymoon. In this crisis, Potter seizes the opportunity again to corral the Building and Loan into his control. He offers George's clients a deal to purchase their savings/shares in the Building and Loan for "50 cents on the dollar"; but George and Mary use the $2000 intended for their honeymoon to weather the financial storm of the townspeople until the Building and Loan's funds are restored. This decision is not easy for George, he hesitantly states to the mob:

> Now, just remember that this thing isn't as black as it appears. I have some news for you folks. I was just talking to old man Potter and he's guaranteed cash payments at the bank. The bank's going to reopen next week.

The mob though is unsatisfied with not being able to withdraw all their money, and as one person states that they have taken Potter up on the deal, the crowd begins to clamor for the door. George pleads with them to remain faithful and honor their agreement; the point is raised that people have bills to pay and families to feed; Potter's deal will see those things come to pass. Mary speaks up and asks how much they need. George persuasively says, "Hey! I got two thousand dollars. Here's two thousand dollars. This'll tide us over until the bank reopens." George and company are able to make until close with only 2 dollars to spare. The Building and Loan survives to see another day of business because of George's decision making. George did not have to offer his $2,000 of honeymoon money, Mary did not need to remind him they had it, in fact Mary had urged George not to stop and see what was happening at the Building and Loan, she pleaded, "George, let's not stop. Let's go…. Please, let's not stop, George."

Instead George left the taxi and his wife to confront the crowd and open the doors to the

Building and Loan. This scene exemplifies Sartre's concept of experiencing forlornness. George chooses to confront this situation that barely avoided disaster because of his choice. Not only was he acting as the 'law maker', as with anguish where he felt the burden that was his choice. George also could not find guidance on how he should chose. There was not 'a priori' option that he could cling to for guidance. Potter did indeed make him an offer that would have saved the Building and Loan, but George scorned it and made a choice that could have condemned the business. Despite his enthusiasm to use the money when it was offered, at the close George laments his decision when he realizes Mary has left and that all but two dollars of their honeymoon money is gone. When speaking to her on the phone his first sentence is to immediately apologize. We can understand about the idea of forlornness in this scene as the inescapable burden one feels to make a decision despite knowing that no one can give them the 'right' answer, we like George are alone to make our choices.

The next aspect that arises in the film is clearly present in two separate scenes. This experience is what Sartre labels as Despair. In *Existentialism* Sartre writes:

> [Despair] means that we shall confine ourselves to reckoning only with what depends upon our will, or on the ensemble of probabilities which make our action possible. When we want something, we always have to reckon with probabilities. (29)

In other words Sartre is describing how a human is nothing other than their plan; a person exists only to the extent that they fulfill their self. Thus we are nothing else than the ensemble of our acts, nothing else than our life. This does not mean one person is greater than another because they have fulfilled their self to a greater extent. Instead it is that our acts, the decisions that we make, the choices we make are who we are in the narrowest sense. Sartre is stressing the point that we experience despair because we confine one's self to one's control. This is distinct from forlornness because in that experience it is because there is no 'a priori' that we can seek guidance to make decisions, despite guidance from others, one remains alone in the decision. Despair may seem similar but it is based upon the fact that those decisions we make are confined to what we control. For example, in the aforementioned scene in the film, George may have wanted to just give the Building and Loan patrons all of the money they were asking for. But the vault did not have enough money for the high demand of withdrawals the townspeople were demanding for. That was not a decision George could make because that was beyond his control. To stress the point, the saying "money doesn't grow on trees" was true for George, as it is for all human beings. Of course he would have liked for that to be the case, but it's beyond George's control, hence he could have felt despair.

The second scene that demonstrates despair is on Christmas Eve. While on his way to deposit $8000 for the Building and Loan, George's uncle Billy (also an employee at the Building and Loan) encounters Mr. Potter and proudly shows him the newspaper article about his nephew Harry, who is about to be honored by the president. Absent-mindedly, Uncle Billy leaves the $8000 deposit envelope in the folds of the news- paper. Later, Potter discovers it keeps it. As it happens, that same day the bank examiners were to inspect the Building and Loan's records; George discovers that Billy has lost the money and becomes frantic; he searches everywhere in town for the $8000. In desperation, George takes the blame for this loss and tells Potter that "he" has misplaced the $8000; he appeals to him for a loan to rescue the company. Potter turns George down and proceeds to inform the authorities for 'embezzlement'. Later, George runs to a nearby bridge; remembering that he has a $15,000 life insurance policy, he decides to commit suicide; after all, he concludes, circumstances being what they are, he is "worth more dead than

alive." George is exemplifying what Sartre had written about despair. George very well would have preferred to receive the loan from Mr. Potter, but Potter's response is beyond George's control. Just like George feels like he would prefer not to be arrested but that's beyond his control now. This scene shows George becoming so distraught at this juncture in his life that he finds himself at a point where he thinks the only decision that is within his own control, is to kill himself.

Nietzsche's Existential Concepts in the Film

When George reaches this deep despair, he enters an existential crisis in which he is in a crisis of self-meaning. We see this by George stating that he is worth more dead than alive, and strongly considering committing suicide. At this point in the film, the themes switch from primarily Sartrean, to primarily that of Friedrich Nietzsche. Specifically two very important concepts from his novels *Thus Spoke Zarathustra* and *The Gay Science* are important to my analysis. The transition from Sartre to Nietzsche coincides with the transition in the film, when Clarence, George's guardian angel, enters the film. When George is contemplating jumping from the bridge into a freezing river, Clarence saves George by jumping into the water himself so that George would jump into the waters and rescue him. After this ironic salvation of George, Clarence grants George's wish: to have never been born, never to have existed. Clarence shocks George by showing him what the town would have been like if George had never existed. George experiences what is now Potterville and is in a constant state of rejecting this world that Clarence has thrust him into, thereby forcing George to experience his inexistence. Finally, George ends up running from the prospect of never having existed, George returns to the bridge and calls upon Clarence and God to let him live again. His prayer is answered and George is returned to the moment he met Clarence, but more importantly he is returned to himself, to his town, to his loved ones, to his life. George is transformed and is stunned at how wonderful everything about his life is.

These scenes are where the first of Nietzsche's themes appear. In *Zarathustra* the main character (Zarathustra) says:

> Have you ever said Yes to a single joy? O my friends, then you said Yes too to all woe. All things are entangled, ensnared, enamored; if you wanted one thing twice, if ever you said, "You please me, happiness! Abide, moment!" then you wanted all back. All anew, all eternally, all entangled, ensnared, enamored- oh, then you loved the world. Eternal ones, Love it eternally and evermore; and to woe too, you say: go, but return! For all joy wants-eternity. (Nietzsche 435)

Zarathustra is talking about saying yes to *all* of life, not just some good or bad, but all of it as a whole. George in this case is experiencing the absence of his life, which is initially what he had wanted. Clarence however thrust him into this circumstance, which is what George had wanted at that time. Instead he finds that he would rather affirm his life, saying yes to everything it had entailed, both good and bad. The good being his family and friends, and the bad being the missed opportunities and pending legal problems, George now would say yes to all of it.

Two additional ideas are essential to understanding Nietzsche's concept of the affirmation of life. They too can be found in scenes from the film. The first of these ideas to discuss is 'spirit', or Geist. This idea can be understood as the will to live and not looking to the afterlife but instead to this life. This idea is discussed in the section of *Zarathustra* called *The Convalescent*. This section describes how Zarathustra comes down with a great ailment, and

after slipping into a deep sleep or coma, he awakens weak from the sickness, but recovering and coming back to health, overcoming the sickness (327-333). This is the idea of spirit in Nietzsche, the zest for life to overcome and is needed for individuals to say yes to life and not look towards the afterlife. George very much displays this type of crisis with his spirit, specifically when he goes to the bridge and contemplates and then commits to suicide. This is reiterated when he tells Clarence he wishes he had never been born at all, this shows how his spirit is in crisis. During his experience he finds that his spirit is strong, when we see him return to the bridge and begs, pleads, cries for his life to be returned. George in this scene wants nothing more than to live. In the chapter called *The Awakening* Zarathustra's company of men are seen to experience much of the same love for life, their spirits are strong and much like Zarathustra their souls are convalescents but now begin to find their zest for living (422-423). Zarathustra describes this recovery as a battle against his old archenemy, "the spirit of gravity", and the men are winning the fight (422-423).

The affirmation of life may involves one's spirit, but Nietzsche demonstrates or provides for the reader a way to understand if the reader is affirming their life or if they are instead rejecting it and saying no. He uses an idea called the eternal recurrence to explain this process. Nietzsche writes in *The Convalescent* that Zarathustra is the "teacher of the eternal recurrence" (332). In this Zarathustra describes it as:

But the knot of causes in which I am entangled recurs and will create me again. I myself belong to the causes of the eternal recurrence. I come again, with this sun, with this earth, with this eagle, with this serpent- *not* to a new life or a better life or a similar life, in what is greatest as in what is smallest, to teach again the eternal recurrence of all things, to speak again the word of the great noon of earth and man, to proclaim the overman again to men. (333)

What Zarathustra is describing is a system in which humans must relive one's life not in a similar manner, not a better or worse manner, but in the exact same manner. Nietzsche's *The Gay Science* makes a more explicit description of what Zarathustra speaks. In it Nietzsche writes:

> What, if some day or night a demon were to steal after you into your loneliest loneliness and say to you: "This life as you now live it and have lived it, you will have to live once more and innumerable times more; and there will be nothing new in it, but every pain and every joy and every thought and sigh and everything unutterably small or great in your life will have to return to you, all in the same succession and sequence-even this spider and this moonlight between the trees, and even this moment and I myself. The eternal hourglass of existence is turned upside down again and again, and you with it, speck of dust!
>
> Would you not throw yourself down and gnash your teeth and curse the demon who spoke thus? Or have you once experienced a tremendous moment when you would have answered him: "You are a god and never have I heard anything more divine."(273-274)

George may not be experiencing his life over and over again, but instead he is in experiencing a congruent version of the Eternal Recurrence Nietzsche has written. Nietzsche's Eternal Recurrence in *Gay Science* is a parable I argue. It allows for the reader to place themselves in this experience/situation and then examine their reaction and assess their own spirit, it allows us to question whether or not we have been saying no to life. This recurrence allows for one to challenge if their choices are affirming all of life, or if their spirit is weak and

they are nothing more than 'living dead' looking towards the afterlife and not their current life. The eternal recurrence forces one to answer if they are actually affirming their life if they had to do it all over again for eternity. In that way, George's experience with Clarence is very much about forcing George to answer the question, to which he answers yes, he would live his life rather than say no to it.

The Eternal Recurrence as George's Experience

This final research question deals with what is the phenomenon that causes individuals to return back to the conditions in life that caused their crisis, as the film depicts with George. We see the climax of George struggling over his life and dealing with an existential crisis when he first arrives at the bridge. George is having a crisis due to several specific reasons. His is a crisis over his life's meaning and worth. This is where he thinks he is "worth more dead than alive". Thus suicide seems the only choice for George in his crisis.

Recall Sartre's definition of anguish: it is one's inescapable feeling of total and deep responsibility of choosing for themselves and humanity as a "law maker". Anguish can only be in the presence of freedom (to choose). As Sartre would say we are inherently slaves to our freedom of choice. George's crisis is centered at this very experience, where he is faced between killing himself and living. Forlornness is the feeling of one's feeling that they are utterly alone in their decision with no one and nothing to seek guidance from. Additionally the feeling of despair is the feeling that due to these other two conditions dealing with our freedom of choice we shall confine ourselves to reckoning only with what depends upon our will, or on the ensemble of probabilities which make our action possible. These three feelings have overwhelmed George and are at the core of thrusting George into this crisis, and his decision of committing suicide.

George is about to throw himself off when Clarence finally enters the film. Clarence jumps into the river and cries for help, to which George responds by saving Clarence and thus not killing himself. They are in the bridge house drying off after having been pulled out of the river. Clarence confronts George on contemplating suicide as a means to help his family. George listens and agrees that his plan was illogical from that point of view (not that he was wrong in thinking that he is worth more dead than alive, just that it would not have been in his family's best interest). George instead responds by saying that everyone would have been better off if he had never been born at all. This is a subtle clarification in what George is grappling with in his crisis; consequently it shifts our philosophical view of his experience. He is not necessarily dealing with a crisis rooted solely in anguish, forlornness, or despair, but instead a feeling that is rooted in a question over George's spirit (or lack of) that Nietzsche writes about. This feeling reveals to us a struggle over whether he can affirm life due to this questioning of the state of his spirit. In *Zarathustra* the chapter called *The Honey Sacrifice* mentions how Zarathustra has stopped striving for happiness, and instead is striving for work, roughly described as having honey in his veins (442). This is Zarathustra's realization that the state of his spirit is in question, ultimately revealing the struggle over his ability to affirm his life. George very much is like Zarathustra in this way, where he is challenging how committed he is to living, and saying yes to living his life instead of living only to work. The catalyst for George's crisis is due to monetary and pending legal problems surrounding his work at the Building and Loan. By George stating to Clarence that he still wishes he had never existed at all, he reveals to us that the epicenter of his crisis is not based in anguish, forlornness, or despair over choosing suicide; but his the root of his crisis is a question of not enough/weak spirit because he wants to have "not been born, to have never lived at all". We should then focus on George's subsequent experience with Clarence as

Nietzsche's eternal recurrence. As aforementioned, for Nietzsche the eternal recurrence is a method for one to answer whether or not they are affirming life, which is when people are willing to say yes to any part of their life they must affirm it as a whole, good and bad. The response to this is a measure of one's spirit or zest for life. Thus his experience is to resolve his crisis of spirit, he must answer if he will affirm life and say yes to live again.

Yet the eternal recurrence for Nietzsche was not a literal event but a metaphorical/parable argument for readers to see how to explain answer this question of affirming life for themselves. With *It's a Wonderful Life*, the film offers another means for this philosophical concept to be understood. George's experience with Clarence is the means through which George must answer if he will actually affirm his life and everything it entails. He does not literally live his life all over again for the rest of eternity, as Nietzsche states in *The Gay Science* (271). Instead George is thrust into an existence in the world where he is confronted with the absence of each decision he has made. By confronting each difference in this world, George is forced to realize how his choices in life made that world what he knew. By seeing the number of changes to Bedford Falls and the ones he loves, he is forced to relive his life passively through the absence of his life. From the untimely deaths that he prevented of those he loved (such as his brother Harry as a child), to the moral and financial decay of the town into Pottersvile. Through the experience of the negation of his being, he is reliving his life and choices that he made. Several different times George ask Clarence why a certain thing, person, or event is not the way it is 'supposed' to be. This inquiry is how we can see that George is indirectly reliving his life, but constantly reflecting back to the way the world is suppose to be via what it is now. Clarence helps support this position by explaining how a certain choice of his was the cause of his reality and how the absence of that choice is the cause of the current conditions George is experiencing. This manifestation of the eternal recurrence is to provoke George into resolving his crisis of spirit. The film depicts the constant struggle of George confronting the decisions he has made and the impact they had on his life and the lives of others; thus forcing him to choose if he would affirm those decision (and his life as a whole) again.

We should focus on similarities between Nietzsche's parable in *The Gay Science* and George's experience with Clarence. In Nietzsche's parable he asks us to imagine that we are in our darkest hour. George most definitely is in his darkest hour in the film, considering his crisis and the fact he has found his meaning to be less than if he was dead. Next, Nietzsche asks us to imagine that a Demon comes to us in this moment of our "loneliest loneliness" (Nietzsche 275). I would contend that this is a parable, and as such is not literal, meaning it is not a literal demon but just a device to help us understand the conflict at present. Despite Clarence being depicted as an angel, he comes to George in his darkest moment and is the device by which George comes to understand the conflict at present for himself. We see this both in the guard house when Clarence confronts George about his premises for committing suicide, and again when Clarence thrust George into this experience. Nietzsche goes on with his parable by explaining how the demon states that the reader will now be forced to life their life over and over and over again throughout eternity from beginning to end repeatedly. Clarence does not make this claim but he forces George into an experience where George is confronted with the choices he has made. The moral of Nietzsche's parable is when he asks the reader what their response would be to this demon. Would you curse it and "throw yourself down and gnash your teeth" (273). Would you rejoice and praise it for the gift it has give you? With that Nietzsche then ask a series of questions of the reader to demonstrate the moral of the parable: have you lived a life that despite your darkest hour you would still want to live, good and bad experiences if you would affirm one you must

affirm them all (274). Nietzsche writes, “The question in each and every thing, “Do you desire this once more and innumerable times more?” would lie upon your actions as the greatest weight”(274). In the film George’s experience conforms to this question, with each and every deviation he is confronted with, he is questioning whether he desires the way it is ‘supposed’ to be again instead of this alternative. Nietzsche concludes this passage with, “Or how well disposed would you have to become to yourself and to life *to crave nothing more fervently* than this ultimate eternal confirmation and seal” (274). We see this is the case for George when after experiencing the world in which he does not exist he cries out to the heavens, “I want to be alive, I want to exist again.” This is George’s explicit affirmation of life.

George is then thrust back to his life, just before he meets Clarence. He is overwhelmed by joy, and runs home to his family. A police officer and journalist confront him at his home. George cheerfully responds, “I'll bet it's a warrant for my arrest. Isn't it wonderful? I'm going to jail. Merry Christmas! Reporters…Oh, look at this wonderful old drafty house.” We see how through the eternal recurrence George’s crisis has been resolved he fervently craves this life good and bad. He is joyful because he has faced this experience that Nietzsche describes and his spirit is strong, he joyfully affirms the life that he had once been trying to end. George desires this life so greatly he willingly affirms the conditions that caused his crisis initially, because is overwhelmed at how wonderful this life is. Thus we see how George’s experience is the eternal recurrence that Nietzsche wrote of in *The Gay Science* and as such it explains how an individual may turn back to conditions willingly in life that caused their crisis.

Conclusion

What drew my attention to this film philosophically was the question of how humans (specifically George) can enter an existential crisis where they reject their life, only to have some sort of experience (i.e. psychological like a pseudo out-of-body experience, or alleged revelation) that changes their choice, they now choose/accept life, but does not alter the conditions in life which drove them into that position. I find that the film offers a very concrete explanation for these events when thought in an atheistic existential perspective. Nietzsche’s eternal recurrence is the measuring device individuals use to answer whether or not they have the spirit to live and affirm their life. Which is when people are willing to say yes to any part of their life they must affirm it as a whole, good and bad. George is experiencing this abstract philosophical idea when he is faced with a reality of the world without George Bailey. The means for George experiencing this though can be answered with Nietzsche’s eternal recurrence as the means for an individual to resolve a crisis (with spirit) and affirm their life. The idea that George’s experience is not a revelation or divine intervention is fundamentally supposed because I am using an atheistic existential perspective defined by Sartre, so we may treat the film as an existential work of humans instead of a pop-culture film to watch during the holidays. This method of Sartre’s can make philosophy relevant to non-academics because of film’s relevance and accessibility in Western life. It allows for people like me to engage with something readily identifiable and interesting, and begin realizing we can ask questions that are important in philosophy and culture. I am able to connect ideas for scholars that are pillars in the philosophical tradition, such as Nietzsche and Sartre, with material that engages and is culturally relevant not just to myself but millions of people around the world.

Works Cited

"AFI's 100 YEARS...100 MOVIES." *AFI's 100 YEARS...100 MOVIES*. N.p., n.d. Web. Summer 2012. <http://www.afi.com/100years/movies.aspx>.

Boulé, Jean-Pierre, and Enda McCaffrey. *Existentialism and Contemporary Cinema: A Sartrean Perspective*. New York: Berghahn, 2011. Print.

Detmer, David. *Sartre Explained: From Bad Faith to Authenticity*. Chicago, IL: Open Court, 2008. Print.

It's a Wonderful Life [video Recording]. Dir. Frank Capra. Perf. James Stewart, Donna Reed, Lionel Barrymore, and Henry Travers. Republic Pictures, 1947. DVD.

Kovacs, Andras Balint. "Sartre, the Philosophy of Nothingness, and the Modern Melodrama." *Journal of Aesthetics and Art Criticism* 64.1 (2006): 135-45. Print.

Miller, Victoria L. "'It's a Wonderful Life' Turns 65: Celebrating a Holiday Classic." *Yahoo! TV*. N.p., 09 Dec. 2011. Web. Summer 2012. <http://tv.yahoo.com/news/wonderful-life-turns-65-celebrating-holiday-classic-225600661.html>.

Nietzsche, Friedrich W., and Walter A. Kaufmann. *The Gay Science: With a Prelude in Rhymes and an Appendix of Songs*. New York: Vintage, 1974. Print.

---.*The Portable Nietzsche*. New York: Viking, 1980. Print.

Pamerleau, William C. *Existentialist Cinema*. New York: Palgrave Macmillan, 2009. Print.

Sartre, Jean-Paul. Existentialism And Human Emotions. New York: Philosophical Library, 1957.

Does Travel Broaden the Communicative Mind? The Influence of Crawling on the Development of Communication in the First Year of Life

Ricky David Groner II, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Rick Gilmore, Ph.D.
Associate Professor of Psychology
Department of Psychology
College of the Liberal Arts
The Pennsylvania State University

Abstract

Previous research suggests that the development of early communicative behavior is linked to the onset of independent locomotion. We examined parent reports of communicative behaviors in infants before crawling, and two and six weeks after crawling onset. The findings support a relationship between parent-reported communication behaviors and crawling onset.

Introduction

Infancy marks a crucial stage of development in which both physical and psychological changes rapidly occur. It has been suggested that these changes may be contingent upon one another in order for an infant to develop normally across a number of early milestones. The current study was concerned with the onset of crawling in infants and the communicative behaviors that seem to arise as. Does the acquisition of locomotion in infancy facilitate the development of communication? How profound is this influence?

Locomotor acquisition has even been referred to as the "psychological birth" of the human infant (Mahler, Pine, and Bergman, 1975). Previous research has elucidated locomotor acquisition as a milestone of infancy in which psychological development arises and behavioral clues proliferate (for a review, see Campos, Anderson, Barbu-Roth, Hubbard, Hertenstein, & Withington, 2000). The specific posture in locomotion (for example, the prone position for crawling, as compared to the upright position for walking) has been debated by researchers as to which seems to have a larger influence on psychological development. Mahler and colleagues (1975) proposed that the upright posture and the advent of walking facilitate psychological development, but recent research tends to support the earlier occurrence of crawling as more influential.

The idea that the advent of crawling drives psychological development has been more recently supported by the literature. An interview study by Campos, Kermolian, and Zumbahlen (1992) presented parental reports of large increases in emotional expression (i.e. anger), separation anxiety, attention to distal objects, and checking back to the mother in locomotor infants as compared to those who were pre-locomotor (both conditions included infants with and without experience in a walker). The changes in the infants had brought about changes in the

parents as well, including but not limited to an increase in vocal volume to communicate prohibitions and to enforce discipline, as well as an increase in emotional expression and affection. It is important to note that the results from the infants with and without walker experience were comparable, and that they were later coupled together (Campos et al., 1992). In addition to the socio-emotional developments reported in locomotor infants, they also show noted increases in referential gestural communication following the onset of crawling (Campos et al., 2000). Findings that support this notion were reported in studies examining normal infant populations (Campos, Kermoian, Witherington, Chen, & Dong, 1997), as well as infants experiencing locomotor delay due to spina bifida (Telzrow, 1990; Telzrow Campos, Kermoian, & Bertenthal, 1999; Telzrow, Campos, Shepard, Bertenthal, & Atwater, 1987) and Chinese infants experiencing locomotor delay due to cultural lifestyle pressures (Tao & Dong, 1997). Each study employed similar paradigms in that they examined prelocomotor and locomotor infants' abilities to respond correctly to a point and gaze gesture initiated by an experimenter. The study by Campos and colleagues (1997) reported increases in correct responsiveness to the experimenter's point and gaze in locomotor infants as compared to those who were prelocomotor. The studies examining infants experiencing locomotor delay found increases in responsiveness to point and gaze gestures only after the delayed locomotor abilities were attained. These studies provide a preliminary foundation for the notion that locomotor experience is a driving force for the development of communicative behavior in infancy, as they provide evidence of a relationship between these two developmental trajectories in both normal and delayed conditions.

Referential gestural communication may also be phrased as an infant's responsiveness to another's attempt to engage in joint attention behavior. Joint attention is considered a major milestone in the development of communication, as it provides evidence that the child understands an individual's state of attention whereby the individual can then effectively communicate a distal object or event to the child. Things get even more interesting when a child develops the ability to turn this around and communicate by means of joint attention, as well. Also called initiated joint attention (IJA; Seibert, Hogan, & Mundy, 1982), this newly attained ability opens new doors for early communication in infancy without necessarily using sounds, or later, words.

When an infant attains the ability to move independently, it begins a more independent experience with the environment that surrounds it. These new experiences warrant the need to express interests and emotions with others, typically the mother or caregiver initially. The current study was concerned with a further investigation of the likely influence of crawling experience on these communicative developments, and to provide empirical evidence on the nature of this crucial period of infancy. Based on previous research, we hypothesized that as infants increase in age, the frequency of their communicative behaviors will increase as well. We also predicted that as infants transition through various crawling milestones, the frequency of their communicative behaviors will increase correspondingly.

Methods

Participants

Twenty-three infants (12 female, all European American) and their mothers participated in a study of change in multiple domains of development (e.g., motor, cognitive, social, emotional) during infants' transition to independent locomotion. The current report focuses on

communicative development. Infants were born between 37 and 42 weeks gestational age, with a birth weight greater than 2500g, and without major birth complications. Three infants were already crawling at the baseline pre-crawling assessment and were thus not included in analyses. Of the 20 remaining infants, 17 completed all three assessments (baseline, 2 weeks post-crawling, six weeks post-crawling), two completed two assessments, and one infant completed one assessment. All missed assessments were due to mothers having other commitments. Infants ranged from 25 to 28 weeks of age at baseline (M = 26.10, SD = 0.91), 27 to 44 weeks at 2 weeks post-crawling (M = 36.71, SD = 4.16), and 30 to 48 weeks (M = 40.71, SD = 4.11) at 6 weeks post-crawling.

Procedure

The larger study consisted of three phases of data collection, each of which included home and lab visits: a baseline pre-crawling phase at approximately infant age 25 weeks, an early crawling phase, and an experienced crawling phase. The early and experienced crawling phases were yoked to each infant's onset of crawling. All infants, except for those three that crawled at baseline, participated in a total of three lab and three home visits, one home and one lab visit at each crawling phase. The first home visit (Baseline Home) took place at 25 weeks plus or minus 2 weeks, with the first lab visit occurring one week later (Baseline Lab, pre-crawling). At the first lab visit the parents were given a diary to be completed daily, monitoring their infants' motor activities. An experimenter called weekly to collect parents' recorded information and to determine if the child had begun crawling. Infants were considered to crawl if they could independently move at least 10 feet, regardless of whether they engaged in hands and knees crawling, belly crawling, hitching, or some other variation of independent movement. Once the parents reported crawling, a home visit was scheduled within one week of crawl onset followed by a lab visit one week later (novice crawling: 2 weeks post-crawling). A home visit was scheduled for the fifth week post crawling and a lab visit the following week (experienced crawling: 6 weeks post-crawling). This longitudinal design, therefore, was based on stages of crawling, not infant age. By design, infants were the same age at the baseline assessment but varied in age at the novice (2 week) and experienced (6 week) post-crawling assessments because infants began to crawl at different ages.

At each home visit, mothers were given questionnaires to be completed for that week, which were returned the following week at the lab visit. Of these, the Communication and Symbolic Behavior Scale – Developmental Profile (CSBS-DP; Wetherby & Prizant, 2002) was the measure of choice for the current study. At each lab visit, infants were first given several minutes to acclimate to the surroundings. Anthropometric measurements and a crawling assessment in which the experimenter verified crawling status were also conducted.

The CSBS-DP is a three-part evaluation tool used to assess the development of communication in infants ranging in ages six to 24 months, primarily used in clinical and research applications to identify developmental deficits that may lead to later disorders (Wetherby, Allen, Cleary, Kublin, & Goldstein, 2002). It is a tool for determining the stage of communicative development of the infant. The entire assessment consists of an initial screening, a caregiver questionnaire, and a face-to-face behavioral evaluation. The caregiver questionnaire is comprised of 41 multiple choice items and four open ended questions organized over three distinct composites: social, speech, and symbolic. The social composite measures aspects of early social expression, including emotion and eye gaze, communication, and gestures. The speech and symbolic composites measure increasingly complex expressions including sound and

word production, as well as evidence of understanding and object use. The sub-scales of the symbolic composite were excluded from our analyses because the measured behaviors of these sub-scales are not seen in infants of our observed age range. In addition, we included only one sub-scale of the speech composite (‘Sounds’, but not ‘Words’).

Typical employment of the CSBS-DP involves an initial screening of the infant subject in order to identify their developmental “age.” If the infant performs at the level of their chronological age or higher, they can be additionally screened every three months, so long as the infant remains within the age range of six and 24 months. However, if the infant does not perform at the level of their chronological age, then further evaluation is recommended to fully assess the developmental condition. For the current study, the caregiver questionnaire was used to collect data at each time period of interest. The behavioral evaluation was excluded because the infant subjects were thought to be too young to produce any meaningful results.

The two-part hypothesis of the study stated that communication should develop rapidly during the observed ages of 23-48 weeks, and that crawling acquisition and experience will influence the rate of development. We used sub-scales within the CSBS-DP Caregiver Questionnaire as measures of communicative behaviors across three periods of crawling status: pre-locomotion (before), 1-2 weeks post-locomotion (early), and 5-6 weeks post-locomotion (late). One-way ANOVA tests with Tukey Honestly Significant Differences post hoc analyses ($p<.05$ significance level) and linear regression analyses were applied to the various sub-scales. The data collected from the CQ, as well as the demographics and anthropometrics, were analyzed using R statistical computing and analysis software (R Development Core Team, 2011; Fletcher, 2010; Pinheiro, Bates, DebRoy, Sarkar, & R Development Core Team, 2011).

Results

Emotion and Eye Gaze Sub-scale

A linear regression analysis on the Emotion and Eye Gaze sub-scale reported that age in weeks was a significant predictor of scores, $\beta = 0.38$, $p = 0.004$, $R2 = 0.13$. Figure 1 provides a scatter-plot of individual scores by age. The figure also shows crawling status at each assessment point. The sub-scale score means were not found to be significantly different across crawling status conditions, $F(2, 54) = 2.38$, $p = 0.102$.

Communication Sub-scale

A linear regression analysis conducted on the Communication sub-scale also revealed age as a predictor of sub-scale scores, $\beta = 0.49$, $p = 0.000$, $R2 = 0.23$. Figure 2 provides a scatter-plot of individual scores by age in weeks. Unlike the Emotion and Eye Gaze sub-scale score means, the Communication sub-scale score means were found to be significantly different across crawling status conditions after an analysis of variance was applied, $F(2, 54) = 7.12$, $p = 0.002$. The mean scores for the before condition ($M = 4.82$, $SD = 3.52$, $N = 21$) were not significantly different from the mean scores of the early condition ($M = 7.57$, $SD = 3.49$, $N = 21$), but were significantly lower than the mean scores of the late condition ($M = 9.32$, $SD = 3.74$, $N = 21$).

Gestures Sub-scale

The Gestures sub-scale scores were found to positively correlate significantly with infant age, $\beta = 0.80$, $p = 0.000$, $R2 = 0.63$. Figure 3 provides a scatter-plot of individual scores by age in weeks. The sub-scale score means were additionally found to be significantly different across

crawling status conditions after an analysis of variance was applied, $F(2, 54) = 13.79$, $p = 0.000$. The mean score for the before condition ($M = 1.88$, $SD = 0.99$, $N = 21$) was significantly lower than the mean scores of both the early ($M = 4.95$, $SD = 2.38$, $N = 21$) and late ($M = 6.00$, $SD = 3.25$, $N = 21$) conditions. The mean score for the early condition was not significantly lower than the mean score for the late condition.

Sounds Sub-scale

The Sounds sub-scale was the only component of the Speech Composite measure included in the data collection. A linear regression analysis also found that age predicts Sounds sub-scale scores, $\beta = 0.63$, $p = 0.000$, $R2 = 0.39$. Figure 4 shows the graphical representation of this trend. The mean scores of the sub-scale were found to be significantly different across crawling status, $F(2, 54) = 12.01$, $p = 0.000$. The mean score for the before condition ($M = 6.59$, $SD = 1.54$, $N = 21$) was significantly lower than both the mean scores of the early ($M = 9.57$, $SD = 2.48$, $N = 21$) and late ($M = 10.26$, $SD = 2.83$, $N = 21$) conditions. The mean scores of the early and late conditions were not found to be significantly different.

Discussion

The linear regression analysis of the function of scores across age for the Emotion and Eye Gaze sub-scale resulted in a positively significant correlation between the ages of 25-48 weeks and test scores. This provides evidence that behaviors measured by this sub-scale are developing within this age range. However, results from the ANOVA on the Emotion and Eye Gaze sub-scale did not yield significance between the before and early crawling conditions. Crawling may not play an influential role in the development of such behaviors as self-generated eye gaze shifts between objects and individuals, positive emotional expression paired with gazes toward individuals, and the responsiveness to another individual's joint attention behavior. The scores were also relatively high compared to the other sub-scales, suggesting that the development of these behaviors has already been established preceding locomotor acquisition.

The observed age range was also found to be significantly correlated with scores on the Communication sub-scale. Therefore, the represented behavioral measurements of this sub-scale seem to be developing rapidly as well. In addition, the means from the Communication sub-scale were statistically significant between the pre- and early crawling conditions, in which the early condition mean score was significantly higher than the pre-crawling condition. This may suggest that crawling acquisition plays an influential role in the development of behavioral regulation, communicative acts to draw attention to oneself, and IJA behaviors. The frequency of deliberate communicative acts may also be included as well. Rapid developments in social referencing communication have been demonstrated in children transitioning from crawling to walking (Clearfield, Osborne & Mullen, 2008). Although we were chiefly interested in crawling acquisition, Clearfield and colleagues' results, as well as the results from the current study, present support for the role of locomotor acquisition in the development of communication as considerably influential.

The Gestures sub-scale scores were also found to be positively correlated with the observed age range. This may be evidence of a rapid development of gestural communication during this period of infancy. Results were significant between the mean scores of the pre- and early crawling conditions as well. Compared to the other sub-scales, the Gestures sub-scale yielded the most significant results from both the linear regression analyses and the ANOVA,

providing strong support that the development and use of both conventional and distal gestures may be influenced by crawling experience.

The Sounds sub-scale produced significant results, in which scores were positively correlated with age. Just like the other three sub-scales, this suggests that the production of rudimentary sounds is rapidly increasing during the observed age range. As with both the Communication and Gestures sub-scales, the Sounds sub-scale mean scores were also significantly different between the before and early crawling conditions as well. This may suggest that crawling experience even plays a role in the ability to produce consonant sounds, as well as the size of the inventory of consonant syllables in which an infant can access.

There were some inherent limitations in the current study. Although the sub-scales were designed to measure and predict communicative behaviors in infants, the scores are ultimately a representation of the mother or caregiver's subjective evaluation of their child. Infants cannot simply be asked questions and be expected to give thorough, scientifically acceptable answers. Therefore, our data is an indirect measurement of infant communicative behaviors, filtered through the interpretation of the parent or caregiver. We encourage the further study of a larger age range using non-linear analyses to more accurately predict the influence of crawling on developmental trajectories.

Overall, our hypotheses were largely supported by the results of the CQ. Crawling acquisition and experience seem to be providing new opportunities for the use of a number of communicative behaviors and facilitating their development. Although behaviors like alternating eye gaze shifts and the responsiveness to joint attention were not significantly affected by crawling, these behaviors may serve as developmental precursors to behaviors that develop after the onset of crawling, where crawling provides the necessary opportunities for these precursor behaviors to evolve.

References

Campos, J. J., Anderson, D. I., Barbu-Roth, M. A., Hubbard, E. M., Hertenstein, M. J., Witherington, D. (2000). Travel broadens the mind. Infancy, 1(2), 149-219.

Campos, J. J., Kermoian, R., Witherington, D., Chen, H.,&Dong, Q. (1997). Activity, attention, and developmental transitions in infancy. In P. J. Lang&R. F. Simons (Eds.), Attention and orienting: Sensory and motivational processes (pp. 393–415). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Campos, J. J., Kermoian, R.,& Zumbahlen, M. R. (1992). Socioemotional transformations in the family system following infant crawling onset. In N. Eisenberg & R. A. Fabes (Eds.), Emotion and its regulation in early development (pp. 25–40). San Francisco: Jossey-Bass.

Clearfield, M. W., Osborne, C. N., & Mullen, M. (2008). Learning by looking: Infants' social looking behavior across the transition from crawling to walking. Journal of Experimental Child Psychology, 100, 297-307.

Fletcher, T. D. (2010). QuantPsyc: Quantitative Psychology Tools. R package version 1.4. http://CRAN.R-project.org/package=QuantPsyc

Mahler, M. S., Pine, F., & Bergman, A. (1975). The psychological birth of the human infant: Symbiosis and individuation. New York: Basic Books.

Pinheiro, J., Bates, D., DebRoy, S., Sarkar, D., & R Development Core Team (2011). nlme: Linear and Nonlinear Mixed Effects Models. R package version 3.1-100.

R Development Core Team (2011). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

Seibert, J. M., Hogan, A. E., & Mundy, P. C. (1982). Assessing interactional competencies: The early social communication scales. Infant Mental Health Journal, 3, 244 – 258.

Tao, S., & Dong, Q. (1997). Referential gestural communication and locomotor experience in urban Chinese infants. Unpublished manuscript, Beijing Normal University, Beijing, China.

Telzrow, R. (1990, April). Delays and spurts in spatial-cognitive development of the locomotor handicapped infant. Paper presented at the Annual Meeting of the International Conference on Infant Studies, Montreal, Canada.

Telzrow, R., Campos, J. J., Shepherd, A., Bertenthal, B. I., & Atwater, S. (1987). Spatial understanding in infants with motor handicaps. In K. Jaffe (Ed.), Childhood powered mobility: Developmental, technical and clinical perspectives (pp. 62–69). Washington, DC: Rehabilitation Engineering Society of North America.

Telzrow, R. W., Campos, J. J., Kermoian, R., & Bertenthal, B. I. (1999). Locomotor acquisition as an antecedent of psychological development: Studies of infants with myelodysplasia. Unpublished manuscript, University of California, Berkeley, CA.

Wetherby, A. M., Allen, L., Cleary, J., Kublin, K., & Goldstein, H. (2002). Validity and reliability of the communication and symbolic behavior scales developmental profile with very young children. Journal of Speech, Language, and Hearing Research, 45, 1202-1218.

Wetherby, A. M., & Prizant, B. M. (2002). Communication and symbolic behavior scales developmental profile. Baltimore, Maryland: Paul H. Brookes Publishing Co., Inc.

Appendix

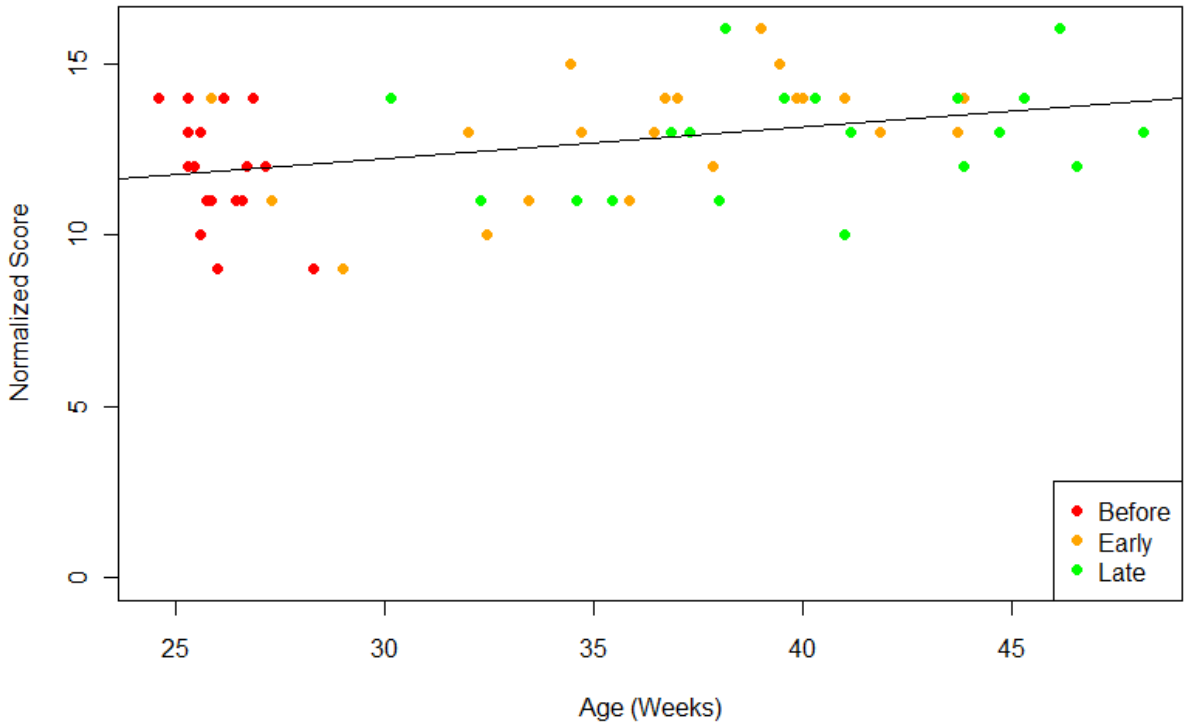


Figure 1. Emotion and Eye Gaze Sub-scale Scores across Infant Age in Weeks.

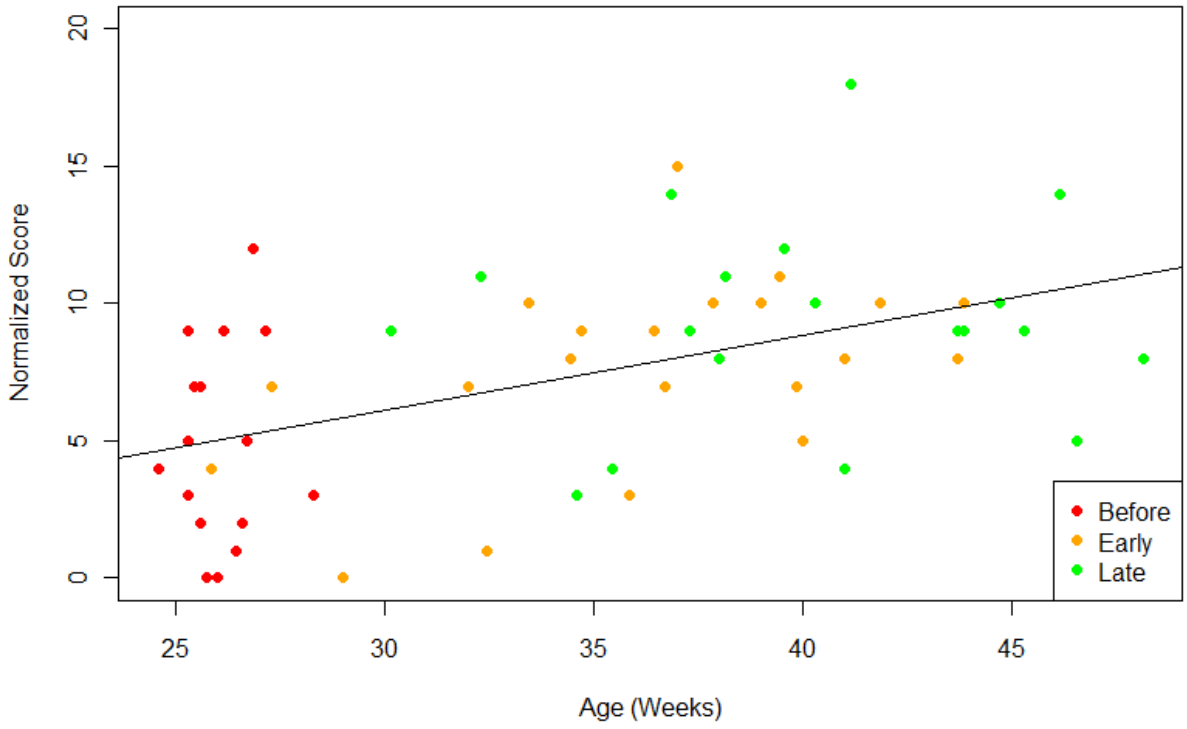


Figure 2. Communication Sub-scale Scores across Infant Age in Weeks.

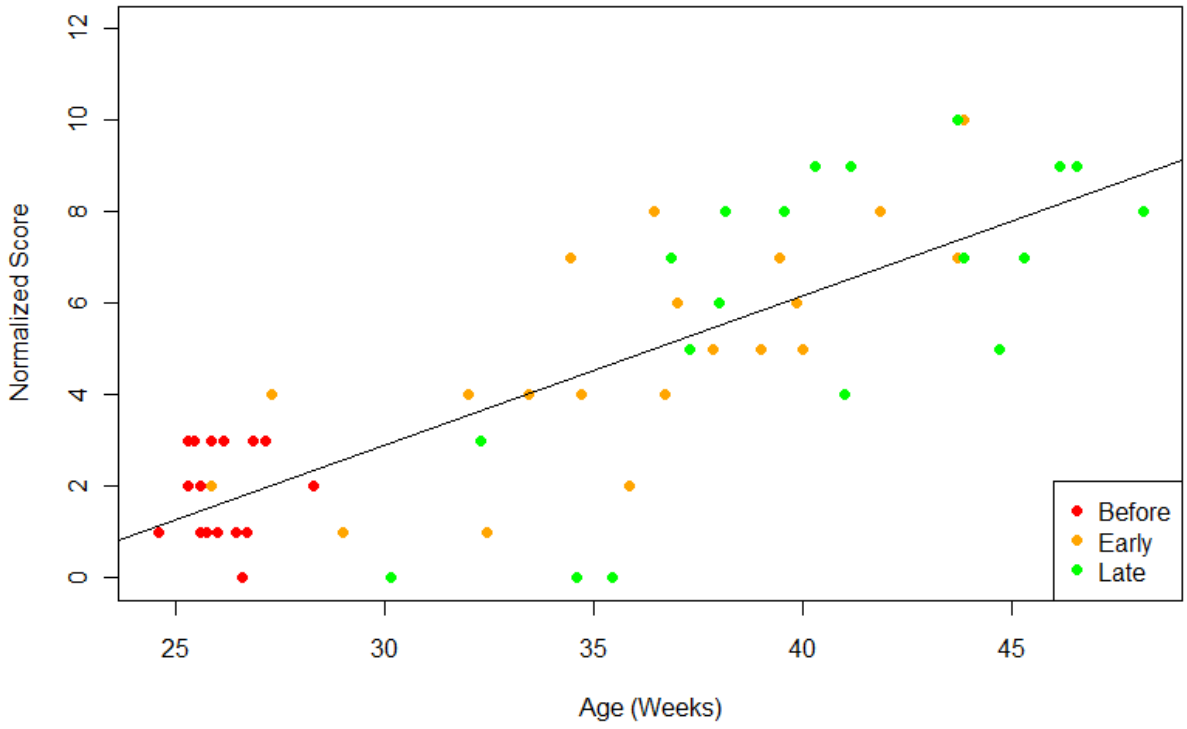


Figure 3. Gestures Sub-scale Scores across Infant Age in Weeks.

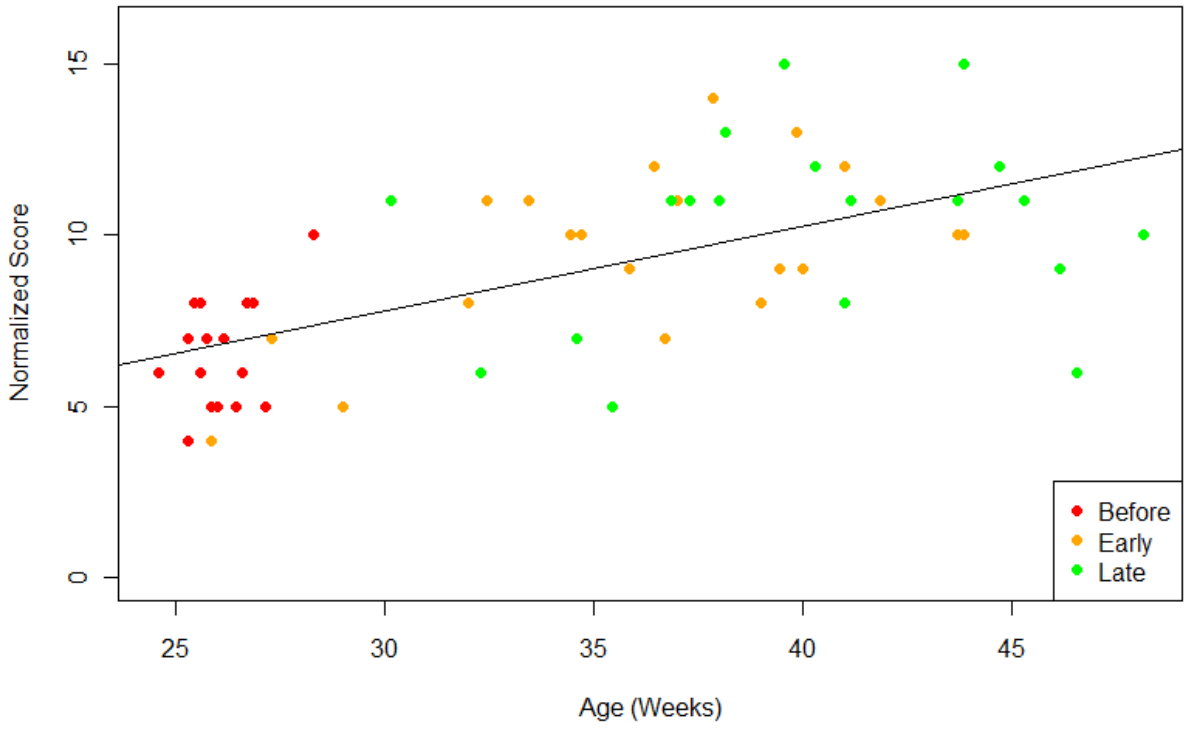


Figure 4. Sounds Sub-scale Scores across Infant Age in Weeks.

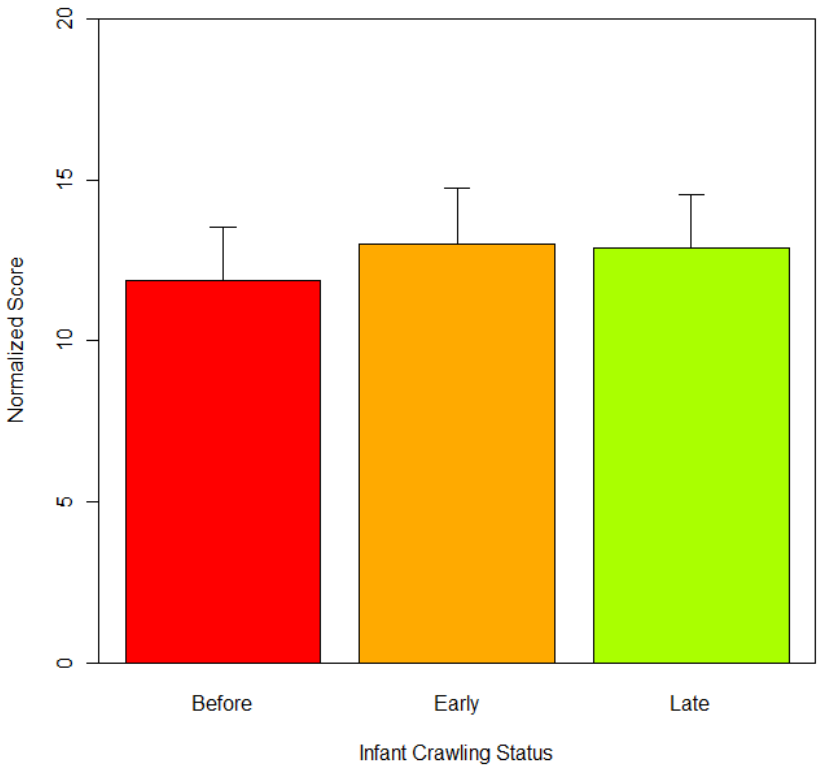


Figure 5. Emotion and Eye Gaze Sub-scale Mean Scores for Crawling Status Periods.

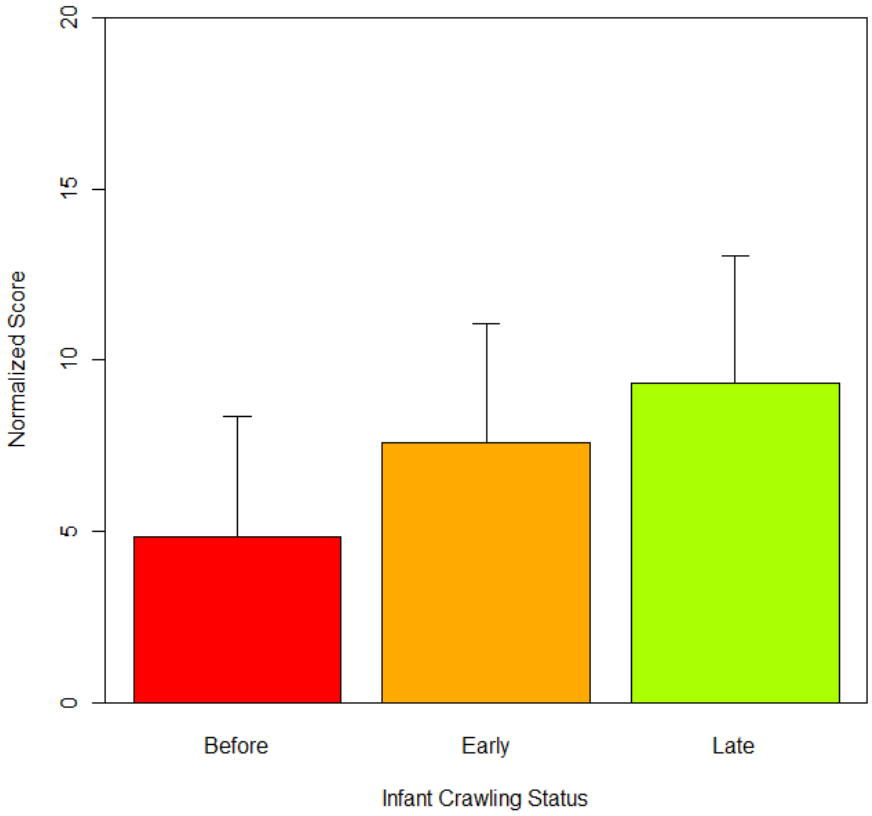


Figure 6. Communication Sub-scale Mean Scores for Crawling Status Periods.

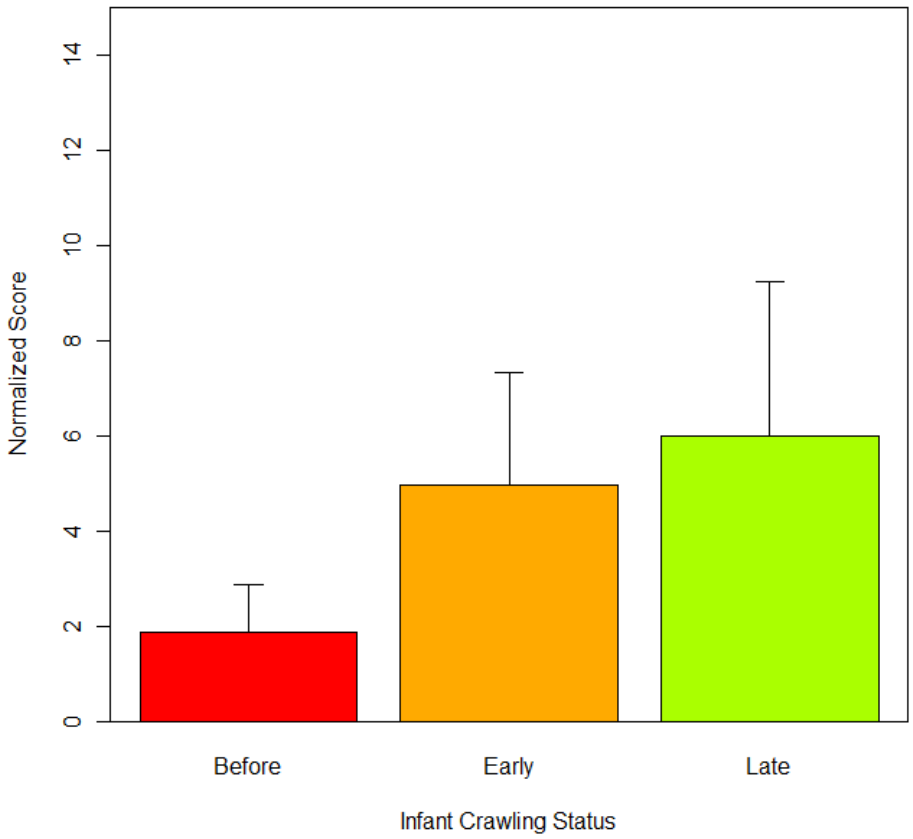


Figure 7. Gestures Sub-scale Mean Scores for Crawling Status Period.

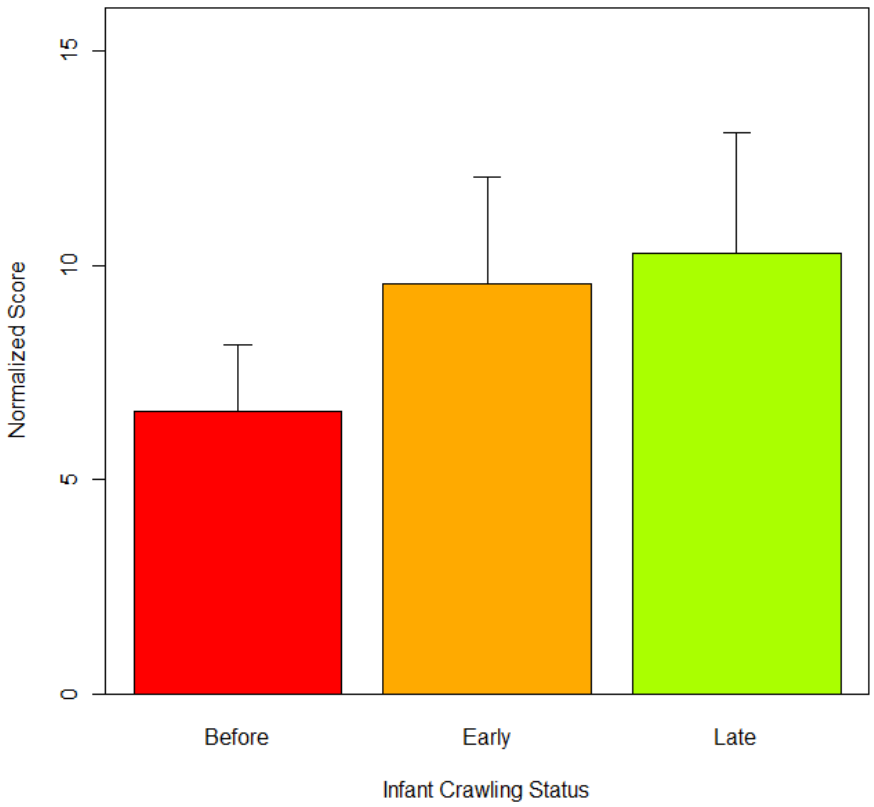


Figure 8. Sounds Sub-scale Mean Scores for Crawling Status Periods.

Does it make a Difference? An Examination of Intensive Academic and Social Supports Influence on Students of Color Post-Secondary Attendance

Roseilyn Guzman, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Leticia Oseguera
Assistant Professor in Higher Education
Department of Education Theory and Policy
College of Education
The Pennsylvania State University

Abstract

Academic and social supports are essential factors for the development of students of color during their high school career. These types of support enable students of color to maintain their motivation to graduate from high school. Additionally, academic and social supports provide students the necessary resources to enhance their cognitive and social skills. While there is no predetermined level of how much support students of color need to pursue a college degree upon high school graduation, I am determining whether one particular college condition, namely intensive academic and social supports, from Jeannie Oakes' (2003) conceptual model does influence students of color's post-secondary attendance. I discovered that the levels of both academic and social support vary across gender and race, specifically, among students of color and their white peers, and while I was not able to determine if there is an existing relationship between receiving both intensive academic and social supports and its influence of students of color decisions to pursue a college degree, it appears that students of color have less access to intensive academic and social supports during high school.

Introduction

For over fifty years, the United States education system has undergone a number of changes to provide equal educational opportunities for students of color. Tracing back to time, the *Brown v. Board of Education of Topeka* (1954), court cased over ruled the decision of *Plessy v. Ferguson* (1896) court cased which at the time was to have "separate but equal educational facilities." Since the over ruling of this court decision, the *Brown v. Board of Education of Topeka* led the way to other important events such as integration and the civil rights movement. Therefore, this historical event has enabled students of color specifically those who are African Americans and Hispanics to receive equal educational opportunities and share educational facilities with their white peers.

Even though students of color should be enjoying the luxury of equal educational opportunities, there is a lack of resources within the schools these students attend that prohibit them from pursuing a college degree (McLure & Child, 1998; Myers & Schirm, 1999). Out of all

the resources these students' schools lack, academic and social supports is by far one of the most critical resources needed for students to succeed (Saunders & Serna, 2004). When there is a lack of funding, students do not receive exposure to college preparation programs, qualified teachers, adequate school conditions, etc. (Myers & Schirm, 1999; Gullatt & Jan, 2003; Oakes, 2003; Myers, et. all, 2004). Due to the lack of resources within these schools, African Americans and Hispanics continue to struggle to apply, enter, and remain in college (Myers & Schirm, 1999; Myers, et. all, 2004; Gullatt & Jan, 2003; Saunders & Serna, 2004; Bergin, Cooks, Bergin, 2007). Several researchers have concluded that students of color are highly successful when they receive either academic or social support through their participation in a pre-collegiate preparation program or within their schools and home (Myers, et. all, 2004; Gullatt & Jan, 2003; Saunders & Serna, 2004; Bergin, Cooks, Bergin, 2007). Thus, graduating from high school is a milestone that many teenagers want to accomplish yet many do not have access to these important resources to be successful and while obtaining a college degree has become *the* definition of success for many students, few students of color compared to their white peers move on to college after high school completion.

For many students of color (Hispanics and African Americans) who represent working-class and ethnic minority backgrounds, attending college is simply a dream. Many researchers argue that students of color, especially those from a working-class background, lack access to many resources that would enable them to pursue a college education. Major challenges such as the admissions and financial aid processes, attainment of high test scores, alienation, and several other factors, may inhibit underrepresented students from continuing their education (Gullatt & Jan, 2003; McLure & Child, 1998; Myers & Schirm, 1999; Myers, et al. 2004; Saunders & Serna, 2004). It is important to have college opportunities because in college, students have the opportunity to develop strong cognitive and social skills, which can be transferred to multiple communities such as one's immediate family and college setting. More broadly, completing a post-secondary education prepares students to participate in democratic deliberation and innovative economies (Gullatt & Jan, 2003; Myers et al., 2004). According to King (2009), it is "estimated that 15% to 20% of the annual average growth in gross domestic product for the United States is explained by increases in educational levels" (p.1). Therefore, if these students are unable to attend college, they will have difficulty with social mobility.

A number of students of color receive academic and social support during high school which enables them to be better equipped for college. Research has been conducted to examine the impact of each support type individually however, not much research has been done to analyze how the levels of these supports vary. Therefore, for the purposes of this study I concentrate on intensive academic and social supports' influences on students of color's post-secondary attendance. Moreover, this study seeks to analyze how the levels of academic and social support vary across gender and race. The research questions guiding the study are: what is the relationship between intensive academic and social supports and college attendance? Are there college attendance differences by race and gender? I hypothesize that when students of color are provided both intensive academic and social supports their likelihood of attending a post-secondary institution increases. In particular, I hypothesize that the levels of support will vary across gender; males will have higher level of support than females. Alongside, the levels of support will vary across race; more specifically white students will have higher levels of support compared to students of color.

Literature Review

The literature has shown that when students of color receive support from their teachers, parents, and peers, they feel more inclined to graduate from high school (McLure & Child, 1998; Oakes, 2003; Zwerling & London 1992). Besides graduating from high school, the support of these people is essential for these students success. Many researchers have described this type of support as social support (Saunders & Serna, 2004). Researchers, Saunders and Serna (2004) have defined social support as the interaction between students and mentors who provide guidance and who are present in the student's lives. Furthermore, Saunders and Serna (2004) along with Gullatt and Jan (2003) agree that "In education, students with limited capital benefit from the development of relationships with caring educated adults" (p.148). Meaning that students who have low academic expectations, meaning that they do not believe they have the potential to pursue a degree higher than a high school and/or bachelor's degree highly benefit from relationships with adults who can communicate with them about college. Alongside, researchers agree that even though social support is important, academic support is also an essential piece for students of color to succeed in high school. Thus, when students of color are provided with academic support within their high schools, they are more academically prepared for what college entails.

Social Support

Researchers, Saunders and Serna (2004) argue that students are more likely to succeed due to the social support they receive from peers, educators, and most importantly parents. These researchers Saunders and Serna (2004) present the idea that when students with low-academic expectations (do not plan to complete a bachelor's degree or higher) develop relationship with educated adults; they are more likely to succeed because they have role models from which they can learn and receive moral support. In addition, Saunders and Serna (2004) along with Gullatt and Jan (2003) agree that "In education, students with limited capital benefit from the development of relationships with caring educated adults" (Saunders & Serna, p. 148, 2004). According to researcher Rendon (2006) in order for these students to apply to college upon high school graduation they need to be constantly reminded of their value and to believe in themselves. Rendon (2006) states that "validation does not assume students can form connections on their own and asks college faculty and staff to take the initiative in reaching out to students to assist them to learn more about college," therefore, high schools and college access programs need to build a strong social support foundation for these students to develop the courage to ask for help (p.5).

Intensive Academic Support

Many students of color receive academic support from their participation in college access programs along with the involvement of their teachers and parents in their educational career (Saunders & Serna, 2004; Bergin, Cooks, & Bergin, 2007; & King, 2009). For example, a student of color who resides in a low-income community, might be encouraged by his/her teachers to participate in programs such as GEAR UP and Upward Bound which promote the importance of taking college preparatory courses during high school to enhance the students' writing, reading, and oral skills (Bergin, Cooks, & Bergin, 2007). However, some researchers, Gullatt and Jan (2003), Oakes (2003), have found that students need more than just weekly meetings with tutors; they need intensive academic support throughout their participation in the

program. By intensive academic support, I am referring to students being able to develop strong course-related learning strategies, self-confidence, and most importantly self-advocacy skills (Bergin, Cooks, & Bergin, 2007). If students of color acquire the skills mentioned above, not only will they increase their academic abilities in and outside of the classroom, but they would also be able to practice professionalism (public speaking, communicating in large groups, etc.) among others in their course grade. Additionally, researchers, such as McLure & Child, (1998), Oakes (2003) and Bergin, Cooks, and Bergin (2007), all agree that based on what studies have shown, "when students set goals to achieve and learn in coursework, they have higher grades, greater comprehension, and improved learning compared to students in control conditions" (Bergin, Cooks, & Bergin, p. 6, 2007).

Consequently, providing intensive academic support for students of color will not only enable them to graduate from high school, but to also pursue a college degree compared to their peers who do not receive this type of support. More so, researcher, Myers, et. al. (2004), argued that when analyzing a study conducted in 2000 found that rather than the intensity of the college access program academic curriculum is more important for students of color to remain in the program and continue receiving these resources from ninth through twelfth grade. For instance, Myers, et.al found in the same study that students of color within "Upward Bound would have had larger effects if students remained in the program for longer periods of time" (Myers, et. al., p. 17, 2004). More participation from teachers in the classroom is needed in order for students of color to succeed and potentially apply, enter, and remain in college post-high school graduation (Assouline & Lupkowski-Shoplik, 2012). Thus teachers, counselors, and even parents will have a better understanding of the level of support each student needs in order to be successful.

A Conceptual Framework for Examining the Relationship between Intensive Academic and Social Supports and College Attendance

Jeannie Oakes (2003) developed a comprehensive conceptual framework that consists of essential school elements to ensure the successful preparation of students for college. As a result of Oakes' (2003) wide-ranging experiences in classroom settings she developed a seven condition conceptual model. This model describes seven conditions that middle and upper-class teenagers with college educated parents enjoy in their schools and communities. The seven conditions that schools should consists of are: 1) safe and adequate school facilities; 2) a college-going school culture; 3) a rigorous academic curriculum; 4) qualified teachers; 5) intensive academic and social supports; 6) opportunities to develop a multi-cultural college-going identity; and 7) family neighborhood-school connections. For this study, I have chosen to operationalize condition five: intensive academic and social supports from Oakes (2003) model to examine intensive academic and social supports and their influence on students of color decisions to attend college after high school graduation.

Methods

The literature review for this study was collected through various searches using online databases such as JSTOR, ERIC, and Google Scholar. Journal articles, studies, and reports were used to better understand how academic and social supports have been defined and utilized in the literature on students of color throughout their high school experience. Each type of support was analyzed separately to comprehend its unique role and how much of an impact it had on students of color's college decisions. The journal articles and reports helped me understand how

researchers define academic support and social support and what outcomes they employ in relation to academic and social support. In addition to examining a wide range of empirical studies, for the purposes of this study, I have also chosen to analyze secondary data, the Education Longitudinal Studies of 2002 (ELS2002) provided by the National Center for Education Statistics (NCES), and identify a number of variables from the ELS Codebook to operationalize condition five: intensive academic and social supports from Oakes (2003) model to understand the relationship of this condition to college going.

Data Source and Sample

The data were drawn from the ELS 2002-2006 panel, collected for NCES. The NCES surveyed 14,000 United States tenth graders in spring 2002, and these same respondents were re-surveyed in spring 2004 (when students were asked to report their intended high school graduation status) and in spring 2006 (two years post-high school, assuming a traditional high school path). The final sample of respondents who completed all three surveys included 12,554 youth attending public, religious, and private high schools throughout the United States. Information was also collected from the students' parents, teachers, and school administrators. Even though the final sample of respondents who completed all three surveys included 12,554 youth for the purposes of this study, the sample size I used was 1,244 respondents. Therefore, the tables included in this paper will only provide results that reflected 1,244 respondents who completed all three surveys. This sample size was chosen by randomly selecting 10% of entire sample of ELS. This decision was made because the primary purpose of this paper was to learn how to do good research within a short nine-week summer research program time-frame and it was a useful exercise to explore the actual data as an initial step of conducting research.

Variables

Within the ELS files, the L appendix included entire set of variables within the database. The ELS: 2002 Electronic Codebook (ECB) and Data Analysis System (DAS) consisted of an extensive list of variables and my first step was to identify those variables most relevant to this study. In order to apply what was found in the literature searches, I mainly focused on marking survey question items that surveyed tenth graders (coded as "bys") and twelfth graders (coded as "f1s") as well as their parents, teachers, and school administrators. Ultimately, for this study, I utilized survey responses from three sources. The first set of variables identified questions that were asked in the student survey (coded as BYS).The second set of variables referred to questions asked to the parent of the student (coded as BYP), and the third set of variables focused on questions that were asked to the school administrator at the school the student attended (coded as BYA).

To make data analysis manageable and to help arrive at a reduced list of five variables from hundreds of possible variables, I created an excel sheet where I listed all variables that related to academic and social supports. After all the variables were listed in the excel sheet, I focused on those that described both types of support. By focusing on variables that only described both academic and social supports I was able to omit a number of variables thereby reducing the variables I would ultimately analyze. To select each variable that represented both academic and social supports, I had to defend how it offered academic and social support to students of color during their high school career.

Again for purposes of this research study exercise, the variable selection was limited to five variables that represented both academic and social supports and which were derived from the student, parent, and administrator surveys. The variables chosen were: BYS41D, BYS41G, BYP69B, BYA12B, and BYA12C. The first variable asked students whether they participated in academic honor society (coded as BYS41D). Variable BYS41G asked students whether they participated in school academic club. The third variable asked respondents whether their parents have set family rules about doing homework (coded as BYP69). Variable BYA12B asked the school administrator to provide the percentages of students who participated in a work study program. Lastly, the fifth variable asked the school administrator to provide the percentages of students who participated in an academic counseling program (coded as BYA12C). Table 1 provides a more detailed justification of how each variable potentially represents how students simultaneously received academic and social supports.

Table 1. Description of Variables

Variable Name	**Variable Label**	**Characteristic of Academic Support**	**Characteristic of Social Support**
BYS41D	Participated in academic honor society	Encourage students to maintain good grades Increase class participation to obtain good grades Behavior performance	Build a circle of friends with similar interests Peers encourage student to continue doing well
BYS41G	Participated in school academic club	Assistance from expert (tutor/teacher) in the subject area	Interact with other students Create study groups Share knowledge with other students
BYP69B	Parents who set family set rulers for 10th grader about doing homework	Students feel the need to complete homework	Parents are encouraging children to have discipline
BYA12B	Percentages of students who participated in a work study program	Provide opportunities to study in their working place Develop management skills Develop deadline commitments	Develop communication, leadership, and organization skills Receive guidance to be prepare for the workforce
BYA12C	Percentages of students who participated in an academic counseling program	Counselors provide advice on course schedule; educational plans post-high school; suggestion for extracurricular involvement/ jobs	Counselors provide advice on life decisions; familial issues

Data Cleaning and Data Analyses

As an analytic strategy, I ran initial frequencies, recoded variables,, and ran descriptive statistics such as means and standard deviations on SPSS software. SPSS stands for Statistical Package for Social Sciences. SPSS software if often used to collect, analyzes, and interprets large datasets. The statistical methods in SPSS and the datasets used can vary depending on the study, but for this study, SPSS was used to interpret the ELS 2002-2006 survey. In order to address how non-college and college attendees were distributed by gender and race, I ran frequencies at the beginning of my analyses to find any mistakes I may have made in the data entry. This exercise listed all the values obtained for the chosen variables along with the number of respondents who were assigned to that value. By running frequencies on the chosen variables, I was able to check for accuracy of values and it enabled me to double-check every variable used in this study.

Once the frequencies were run on the chosen variables, I had to recode each variable. I recoded some values in each variable as missing. For example, variable BYS41D consisted of other values such as -6. -4, -2, etc. which meant that students responded with something else than yes or no. As A result the missing values were replaced with means of each variable. Mean replacement is a commonly used method to substitute missing values in small sample data. Finally I ran descriptive statistics to get means and standard deviation for each variable and all three groups. I have provided an explanation of all tables included in the paper. These tables will provide descriptive statistics including percent distribution, means, and standard deviation of students who attended college and those who did not attend college. Table 2 shows the distribution of non-college attendees and college attendees across gender and race. The main purpose of tables 3 and 4 is to showcase the means and standard deviations of non-college and college attendees divided by gender (see table 3) and gender (see table 4). By completing these tables my expectations are to capture whether there are any differences in the selected variables between non-college attendees and college attendees.

Results

Table 2. Distribution of College Attendance by Gender and Race

Table 2 presents the distribution across students who did not attend college and those who attended college. This table was divided into two sub-groups: gender and race. According to table 2, a total of 294 students did not attend college upon high school graduation while a total of 950 students attended college. Based on the data, it can be inferred that more students attended college after graduating from high school. Even though there are a large number of students who attended college after high school graduation, there are significant differences across gender and race distributions.

According to table 2, across college attendees and non-college attendees, males are more prominent in each group. Out of the 294 students who did not attend college, males accounted for 58% of the group. On the contrary side, out of the 950 students who attended college, males accounted for 47% of the total group size (447 male college attendees). In other words, a higher proportion of men are found among the non-college attendees than college attendees. Additionally, females accounted for 42% of the total non-college attendee group (124 female non-college attendees). In comparison to the percentage of female college attendees (53%; 503 female college attendees), the data shows that there is not a significant difference among female

non-college and college groups. More so, the data shows that the percentage of males who do not attend college is higher than that of females. In terms of the distribution of college attendance across race, students of color accounted for 53% (156 students) of the students who did not attend college, compared to their white peers, who did not attend college 47% (138 students). Nonetheless, when comparing students of color who attended college to their white peers who also attended college, there is an existing gap. Students of color only accounted for 41% of the total number of college attendees. Paralleled to their white peers, who accounted for 59% of the total number of college attendees there is a 18% difference among these two groups.

Table 2. Distribution of College Attendance by Gender and Race

	No College (n=294)	College (n=950)
Gender		
Male	170 (58%)	447 (47%)
Female	124 (42%)	503 (53%)
Race		
Students of Color	156 (53%)	391 (41%)
White	138 (47%)	559 (59%)

Table 3. Means and Standard Deviations by Gender

In table 3, the data presented displays the means and standard deviations of non-college attendees and college attendees by gender. The overall sample means are also presented in order to show the average level of each variable. In examining whether a student participated in an academic honor society, non- college attendees have lower average levels of participation than college attendees. Among the non-college attendees, only 5% of female and 5% of male students participated in academic honor society whereas 12% and 10% of college attendees did. In terms of school academic club participation, non-college attendees also have lower participation rate on average. Among non-college attendees, only 8% of females and 3% of males participated in school academic club compared to the participation of college attendees where 12% of females and 9% of men participated. Among the females, similar rates of participation are identified with respect to participating in an academic honor society or a school academic club.

When asked whether respondents' family has set rules about doing homework, non-college attendees have lower levels of family rules about doing homework. In this case, 87% of female and 92% of male reported that they did not have family rules about doing homework while their college attendee peers both reported that 91% of them had family rules about doing homework. Even though there was a difference in percentages among non-college and college females, the average across groups is similar. Based on the date presented in table 3, the non-college attendees attend high schools with students who have lower participation rates in both work study and academic counseling programs. Thus, non-college attendees came from high schools with greater participation rates in work study programs (see the mean of non-college females=7.97 whereas the mean of college females=8.64). However when comparing males who came from high schools with high participation rates in work study programs (see the mean of non-college males=9.40 whereas the mean of college males=8.81), it shows that in terms of work study participation non-college attendees might have higher aspirations for getting jobs

rather than attending college after graduating high school. Lastly, the high school administrator reported that students who did not attend college came from high school with low rates of participation in academic counseling programs (see the mean of non-college female=78.94 while the mean of college female=77.91). Nonetheless, college males who participated in an academic counseling program have a higher participation rate than all the students (see the mean of college male=77.88 compared to all students mean=76.19).

Table 3. Means and Standard Deviations by Gender

Variable	Scaling	No College			College		
		All (n=294)	Female (n=124)	Male (n=170)	All (n=950)	Female (n=503)	Male (n=447)
Participated in academic honor society	0=no; 1=yes	.05 (.21)	.05 (.22)	.05 (.20)	.11 (.31)	.12 (.32)	.10 (.29)
Participated in school academic club	0=no; 1=yes	.05 (.21)	.08 (.27)	.03 (.15)	.11 (.31)	.12 (.32)	.09 (.29)
Family rules for 10th grader about doing homework	0=no; 1=yes	.90 (.27)	.87 (.30)	.92 (.23)	.90 (.27)	.91 (.26)	.91 (.28)
Percentages of students who participated in work study program	Continuous, 0-50%	8.79 (6.46)	7.97 (5.21)	9.40 (7.20)	8.72 (5.77)	8.64 (5.52)	8.81 (6.10)
Percentages of students who participated in an academic counseling program	Continuous, 0-100%	76.19 (28.26)	78.94 (27.44)	74.18 (28.76)	77.89 (28.21)	77.91 (28.29)	77.88 (28.16)

Note: The decimal numbers outside the parentheses represent the mean and inside the parentheses is the standard deviation of each variable.

Table 4. Means and Standard Deviations by Race

In table 4, the data shows means and standard deviations of non-college attendees and college attendees by race. More specifically, the overall sample means are also presented in order to show the average level of each variable. In examining whether students participated in an academic honor society, non- college attendees have extremely lower average levels of participation than college attendees. Among the non-college attendees, only 7% of students of color and 3% of white students participated in an academic honor society whereas 7% and 13% of college attendees were participants in an academic honor society. When students were asked about school academic club participation, non-college attendees also have lower participation rates on average. Among students who did not attend college, only 7% of students of color and 3% of white non-college attendees reported participation in a school academic club compared to 9% and 12% of students of color and white students, respectively that participated. According to the data, both students of color and white students who attended college have equal participation rates in an academic honor society and school academic club.

Furthermore, when respondents were asked whether they had set family rules about doing homework, non-college students of color (88%) have the same level of family rules about doing homework than their non-college white peers (91%). In addition, students of color whose family set rules about doing homework have a higher mean than all students (see the mean for students of color college attendee=92% but the mean of all students=90%). However, only 89% of white

students reported to have family rules about doing homework. According to the school administrator's report, non-college students of color come from high schools with lower participation rates in work study programs than students of color who attended college (see the mean for students of color non-college attendee=8.64but the mean of college students of color=8.97). Surprisingly, the mean for white students who did not attend college and participated in a work study program is much higher than that of white college attendees (see the mean for white non-college students=8.97 whereas the mean of white college students=8.40). The data presented on this table shows the high school of students of color who did not attend college and those who did have very close participation rates in academic counseling programs. When comparing students of color who attended college to their white college peers, students of color come from high schools where there is a higher participation rate in academic counseling programs.

Table 4. Means and Standard Deviations by Race

		No College			College		
Variable	Scaling	All (n=294)	SoC (n=156)	White (n=138)	All (n=950)	SoC (n=391)	White (n=559)
Participated in academic honor society	0=no; 1=yes	.05 (.21)	.07 (.25)	.03 (.15)	.11 (.31)	.07 (.26)	.13 (.33)
Participated in school academic club	0=no; 1=yes	.05 (.21)	.07 (.25)	.03 (.17)	.11 (.31)	.09 (.29)	.12 (.32)
Family rules for 10th grader about doing homework	0=no; 1=yes	.90 (.27)	.88 (.27)	.91 (.26)	.90 (.27)	.92 (.23)	.89 (.30)
Percentages of students who participated in work study program	Continuous, 0-50%	8.79 (6.46)	8.64 (6.04)	8.97 (6.92)	8.72 (5.77)	9.18 (6.20)	8.40 (5.44)
Percentages of students who participated in an academic counseling program	Continuous, 0-100%	76.19 (28.26)	78.92 (25.26)	73.10 (31.11)	77.89 (28.21)	78.28 (26.36)	77.63 (29.46)

Note: The decimal numbers outside the parentheses represent the mean and inside the parentheses is the standard deviation of each variable.

Conclusion

Based on my analysis the results indicate that males and females as well as students of color and white students have different levels of academic and social supports. Generally, the mean levels of reported support among college attendees were higher than the non-college attendees which may suggest that having intensive academic and social supports does relate to eventual college enrollment. I do not know whether these differences significantly influence post-secondary attendance post high school graduation because I did not do a significant test which requires another set of strategies. For the purposes of this study, significant difference tests were not needed. The results shown above are the preliminary analyses to further explore the descriptive patterns of my interested variables. For future analysis, I will have to conduct a significant test using t-tests and then regression analysis.

Overall, this study enabled me to understand the process of doing a preliminary analysis and become more exposed to research. In order to acquire more significant findings, I would like to apply these analyses to the total sample population. In addition, I would like to explore some

of the differences that appeared in terms of support levels across race and gender. Some variables presented that students of color had higher levels of both academic and social support compared to their white peers but the percentages of students of color who attended college was lower than that of white students and I would like to explore this phenomenon more fully.

References

Assouline, S.G., & Lupkowski-Shoplik, A. (2012). The talent search model of gifted identification. *Journal of Psychoeducational Assessment*, 30:45

Bergin, D. A., Cooks, H.C., & Bergin, C.C. (2007). Effects of a college access program for youth underrepresented in higher education: A randomized experiment. *Research in Higher Education*, *48*(6), 727-750.

Gullatt, Y., & Jan, W. (2003). How do pre-collegiate academic outreach program impact college-going among underrepresented students? *Pathways to College Network Clearinghouse*, 1-27.

King, K.A. (2009). A review of programs that promote higher education access for underrepresented students. *Journal of Diversity in Higher Education*, *2*(1), 1-15.

McLure, G.A., & Child, R.L. (1998). Upward bound students compared to other college-bound students: Profiles of nonacademic characteristics and academic achievement. *The Journal of Negro Education*, *67*(4), 346-363.

Myers, D., Olsen, R., Seftor, N., Young, J., & Tuttle, C. (2004). The impacts of regular upward bound: results from the third follow-up data collection. *Mathematica Policy Research Inc*., 1-210.

Oakes, J. (2003). Critical conditions for equity and diversity college access: Informing policy and monitoring results. *University of California*.

Rendon, L.I. (2006). Reconceptualizing success for underserved students in higher education. *National Post-Secondary Education Cooperative*. 1-33.

Saunders, M., & Serna, I. (2004). Making college happen: The college experiences of first-generation Latino students. *Journal of Hispanic Higher Education*, *3*(2), 146-163.

Stoutland, S.E., & Coles, A.S. (2011). How students are making it: Perspectives on getting through college from recent graduates of the Boston public schools. *The Boston Foundation*, 1-88.

Zwerling, L.S., & London, H. (1992). First generation students: Confronting the cultural issues. (New Directions For Community Colleges No. *80*). San Francisco: Jossey Bass.

Beyond Bias and Accuracy: A Review of Analysts' Forecast Process

Yibing Lin, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Dr. Steven Huddart, Ph.D
Professor and Chair of Accounting
Department of Accounting
Smeal College of Business
The Pennsylvania State University

McNair Faculty Research Advisor:
Dr. Henock Louis, Ph.D
Professor of Accounting
Department of Accounting
Smeal College of Business
The Pennsylvania State University

Abstract

During the past few decades, accounting and finance researchers have been interested in analysts' earnings forecast accuracy and stock recommendation profitability. This survey examines articles that explore this issue to determine researchers' methods of studying of this process. This survey found that few researchers study analysts' forecast process directly. Instead, many use the indirect approach of statistical analysis. This research suggests the need to approach analysts about their forecast process directly, for example, by interview.

Introduction

In the past few decades, accounting and finance researchers have been interested in analysts' forecasts. Forecasting is the process of predicting future outcomes, usually those that occur within 1-2 years of the prediction. In accounting and finance fields, the term analysts' forecasts refer to how analysts use financial information, such as company disclosures, other analysts' forecasts, private information from managers, and major news and announcements, to estimate companies' future earnings and stock prices.

Bradshaw (2011) claims that studying analysts' forecasts helps people understand capital market's functions, its structure, the role each market participant plays, and the information flow in the market. Additionally, it provides insight to how the study of analysts' forecasts involves studying the influences of analysts' forecasts in the market,

how each market participant interprets and uses analysts' forecasts information, and how analysts' forecasts information is transferred to each market participant. However, this study is not aimed to provide an inclusive view of every perspective of analysts' forecasts due to the time constraints.

The purpose of this study is to survey literature and provide a summary of research into analysts' forecast process. In particular, we will distinguish two different approaches used to examine analysts' forecast process and discuss the advantages and limitations of both approaches. We will pay special attention to the overlooked and unaddressed questions regarding analysts' forecast process. In addition, as results of this study, we will provide direction for future studies on analysts' forecast process.

This project incorporates the results of literature that has been conducted on different perspectives of analysts' forecasts. For example, Keskek, Myers, Omer & Shelley (2011) discuss forecast characteristics and forecast accuracy. Ramnath, Rock & Shane (2008) explore the taxonomy of research that examines the roles financial analysts play in capital market. Beyer, Cohen, Lys & Walther (2010) summarize the financial reporting environment and company disclosures. This study is based primarily upon Bradshaw's (2011) and Schipper's (1991) studies on analysts' forecast process, which we will revisit later.

This project contains five sections. The first section provides descriptive information on analysts' forecasts. The following section discusses details of analysts' forecast process and the importance of studying this process. In the third and fourth sections, we analyze how researchers have examined analysts' forecast process and what still needs to be done. The final section concludes what we have discussed and provides direction for future research.

What do we know about analysts' forecasts?

Analysts play an important role in the capital market. They serve as "market information intermediaries" by both receiving and transferring financial accounting information to capital market participants, which include clients, investors, and company management (Bradshaw, 2011; Schipper, 1991). The relationship between analysts and capital market participants influences both the participants' trading decisions and the development of an analyst's forecasts. Typically, investors and market clients have access to less information than analysts do. Therefore, Bradshaw (2011) and Keskek, Myers, Omer & Shelley (2011) claim that analysts' forecasts are the basis for some investors' trading decisions, which in turn affect stock prices.

On the other hand, many analysts depend on company managers' insider perspectives to construct their forecasts. If analysts do not communicate with the managers of publicly traded companies, these companies' stock prices may be either adversely or favorably affected by analysts' inaccurate forecasts. Therefore, Bradshaw (2011) and Beyer, Cohen, Lys & Walther (2010) propose that managers from publicly traded companies need to communicate with analysts and provide them with the information they need to make forecasts. For example, managers usually provide forecast guidance to analysts, who can then more accurately forecast the future outcomes

of the managers' companies. In general, both analysts and capital market participants benefit from exchanging private and public information. Analysts receive information from investors and managers in generating forecasts. Managers receive information from analysts and investors in making management decisions. Investors receive information from analysts in making trading decisions.

There occurs an interesting phenomenon of managers' disclosures in the capital market: managers from publicly traded companies tend to disclose bad news about their companies' earnings more often than they disclose good news although the public might expect good and bad news to be equally likely. Skinner (2008) conducted a research to examine reasons behind this phenomenon. According to Skinner (2008), managers run the risk of being sued for holding bad earnings news if the announcements of disappointing actual earnings is a surprise to analysts and investors. In contrast, analysts and investors are pleased with unexpected announcements of positive earnings. In sum, managers would only be punished for holding bad earnings news. As a result, managers feel encouraged to disclose bad earnings news to avoid the risk of being sued. Furthermore, if managers fail to disclose enough bad earnings news and investors are disappointed with manager companies' earnings announcements, managers' reputation suffers. As a result, investors and analysts will not favor their companies' stocks because of the risks associated with holding these stocks.

Analysts usually pick or are assigned to a list of companies for which they regularly provide earnings forecasts and stock recommendations. There are two types of analysts in the capital market: the buy-side analyst and the sell-side analyst. A buy-side analyst typically works for a mutual fund or a pension fund to provide recommendations of which stocks to hold in the portfolio for their respective fund. In contrast, a sell-side analyst usually works for a brokerage firm to evaluate companies' future earnings and offer stock recommendations to the market clients. Previous studies have primarily focused on discussing sell-side analysts since buy-side analysts' recommendations are not publicly disclosed. Additionally, there have been more issues concerning sell-side analysts' earnings forecasts and stock recommendations as well as sell-side analysts' roles in capital market. For example, Groysberg, Healy, Chapman, Shanthikumar, & Gui (2007) claim that sell-side analysts, who are facing more conflicts of interest than buy-side analysts, make more biased stock recommendations. However, only few studies have examined this hypothesis.

Sell-side analysts consist of both affiliated and unaffiliated analysts. By definition, an affiliated analyst works for a firm that has an investment banking relationship with a company that is covered by the analyst. However, an unaffiliated analyst works for a firm that does not have such relationship with companies he covered. Recent scandals on Wall Street concerning sell-side analysts have directed researchers' attention to sell-side analysts. Lin & McNichols (1998), Fang & Yasuda (2005), and Bradley, Jordan & Ritter (2005) argue that affiliated analysts may face a conflict of interest and feel pressured to provide overly optimistic recommendations. Lin & McNichols (1998) found that affiliated and unaffiliated analysts' "Strong buy" and "Buy" recommendations have same profitability. However, stocks that affiliated analysts recommend usually perform poorer than stocks that unaffiliated analysts recommend to

hold. In addition, Lin & McNichols (1998) note that IPOs (Initial Public Offering) recommended by affiliated analysts generally perform worse than IPOs recommend by unaffiliated analysts. Based on these findings, Lin & McNichols (2005) make a logical inference that affiliated analysts have pressure from their employer to offer optimistic recommendations for the benefit of the companies they cover.

Moreover, Schipper (1991) and Bradshaw (2011) also indicate that most analysts' forecasts are optimistic based on observations from hundreds of studies of analysts' forecasts. Almost all of those studies report that analysts' earnings forecasts are higher than actual earning disclosures on average. Researchers refer to this as the bias in analysts' forecast.

Forecast bias does not destroy the usefulness of forecasts as long as the recipient of the forecasts is able to correct for the bias. For example, if we know earnings forecasts and stock recommendations that analysts have made for a typical company are always higher than actual earnings and stock prices, and we are able to find out the difference between the forecast values and actual values. Then, we can simply take the forecast values and subtract from the difference to get accurate information. Suppose we know 50% of earnings forecasts and stock recommendations that analysts have made for a typical company are higher than actual earnings and stock prices, and the remaining 50% are lower than actual earnings and stock prices. We also know that the absolute difference between the forecast values and actual values are same among all the earnings forecasts and stock recommendations. Then, we can simply take the average of all the forecasts analysts have made for this company to get accurate information. However, the problem is investors are not able to distinguish between an upward forecasts bias and a downward forecasts bias. Additionally, investors are not able to detect the difference between the biased forecasts and actual earnings and stock prices before they make a trading decision since earnings announcements and changes in stock prices are usually available after investors have already made a decision. Because of this, it becomes very important for us to be able to examine analysts' decision-making process to find out how analysts generate bias in their forecasts.

Investors and individual market clients make their decisions based on analysts' forecasts. Therefore, Myers, Omer & Shelley (2011) indicate that it is important for investors and individual market clients to get accurate forecast information. Desalvo (1970) states that one of most common ways used by researchers to assess analysts' forecast accuracy is to calculate analysts' forecast errors. Analysts' forecast errors are defined as the difference between actual values and analysts' forecast value. Lapide (2007) suggests that it is also important for analysts to study their forecasts errors, because analysts should be able to detect and learn from their mistakes to improve their forecasts.

Numerous studies have been done to measure analysts' forecast errors and their distribution, most of those studies use the multiple regression model (Desalvo 1970). The input of these studies is a set of an analyst's forecasts errors. However, the possible occurrence of heteroskedasticity is a major concern in the application of regression analysis. Heteroskedasticity occurs when a list of forecasts errors of the companies covered by an analyst are measured in different scales. For example, consider a company

in which the annual earnings are reported in millions, the forecasts errors of this company would be measured in millions. Nevertheless, for companies in which the annual earnings are reported in thousands, the forecasts errors of this company would be measured in thousands. The unequal scales used to measure different companies' forecasts errors create a statistical issue for using multiple regression model. The most common way to solve this problem is to change the magnitude of forecasts error scales to the same level by multiplying or dividing the variables. The test results of an analyst's forecast errors generally provide researchers with a detailed statistical analysis, such as the distribution and standard deviation of this analyst's forecast errors. Those results help us understand each analyst's performance in forecasting. For example, a low standard deviation and a small range of an analyst's forecast errors signifies that this analyst has a consistent forecast performance. The smaller the analyst's forecasts errors are indicates the higher accuracy of this analyst's forecasts.

Bradshaw (2011) and Schipper (1991) indicate that researchers are interested in comparing analysts' earnings forecasts to time-series modeling of earnings. Analysts' earnings forecasts cost thousands of times more than time-series modeling of earnings. Financial and accounting researchers are interested in knowing whether the money spent on analysts is worthwhile since a software model can also perform analysts' tasks. For this reason, a significant amount of research on time-series modeling of earnings has been produced. The null hypothesis in this case is that analysts' earnings forecasts and time-series modeling of earnings perform equally well in predicting earnings. Bradshaw (2011) and Schipper (1991) found that most statistical studies successfully reject this null hypothesis and conclude that analysts are better at predicting earnings than time-series models, which is not a surprise since analysts are able to assess additional information. For example, Schipper (1991) concludes in her paper that many studies found "a stronger association between the market response to earnings and forecast errors based on analysts' forecasts than between the market response to earnings and forecast errors generated from time-series models." However, if those studies fail to reject the null hypothesis, we have to conclude that analysts are as good as time-series models in forecasting earnings. From an economic point of view, this is not an optimal outcome because it would be an allocative inefficiency of using resources on the analysts. Alternatively, we could use those resources to produce other types of goods and services that are more desirable in the society.

According to Bradshaw (2011) and Schipper (1991), the difference in performance between analysts and time-series models is not big, usually between 3-4%. Bradshaw (2011) and Schipper (1991) conclude that with the extra time and information analysts spend to make forecasts, analysts' performance has been considered inefficient up to this point, which is considered as a waste of resources in economic point of view. This is because the resources that analysts spend to make forecasts could have a higher opportunity costs. Such investigation leads researchers to question such as whether the increasing tendency for managers to disclose more information, which includes earnings guidance and earnings preannouncements, would increase analysts' superiority over time-series models. However, Beyer, Cohen, Lys & Walther (2010), Bradshaw (2011), and Schipper (1991) found that few research studies have attempted to examine this area. At this point, Schipper (1991) and Bradshaw (2011) strongly encourage future research on

analyst decision processes such as studies on how analysts actually use financial information, along with what information helps analysts make forecasts that are more accurate.

Since accounting researchers are interested in how financial accounting information is used, it would also useful to study analyst decision processes because analysts are the primary users of financial accounting information. In addition, Schipper (1991) indicates that knowing how financial accounting information is used should make accounting and finance academics more knowledgeable professors and thus more able to teach future students.

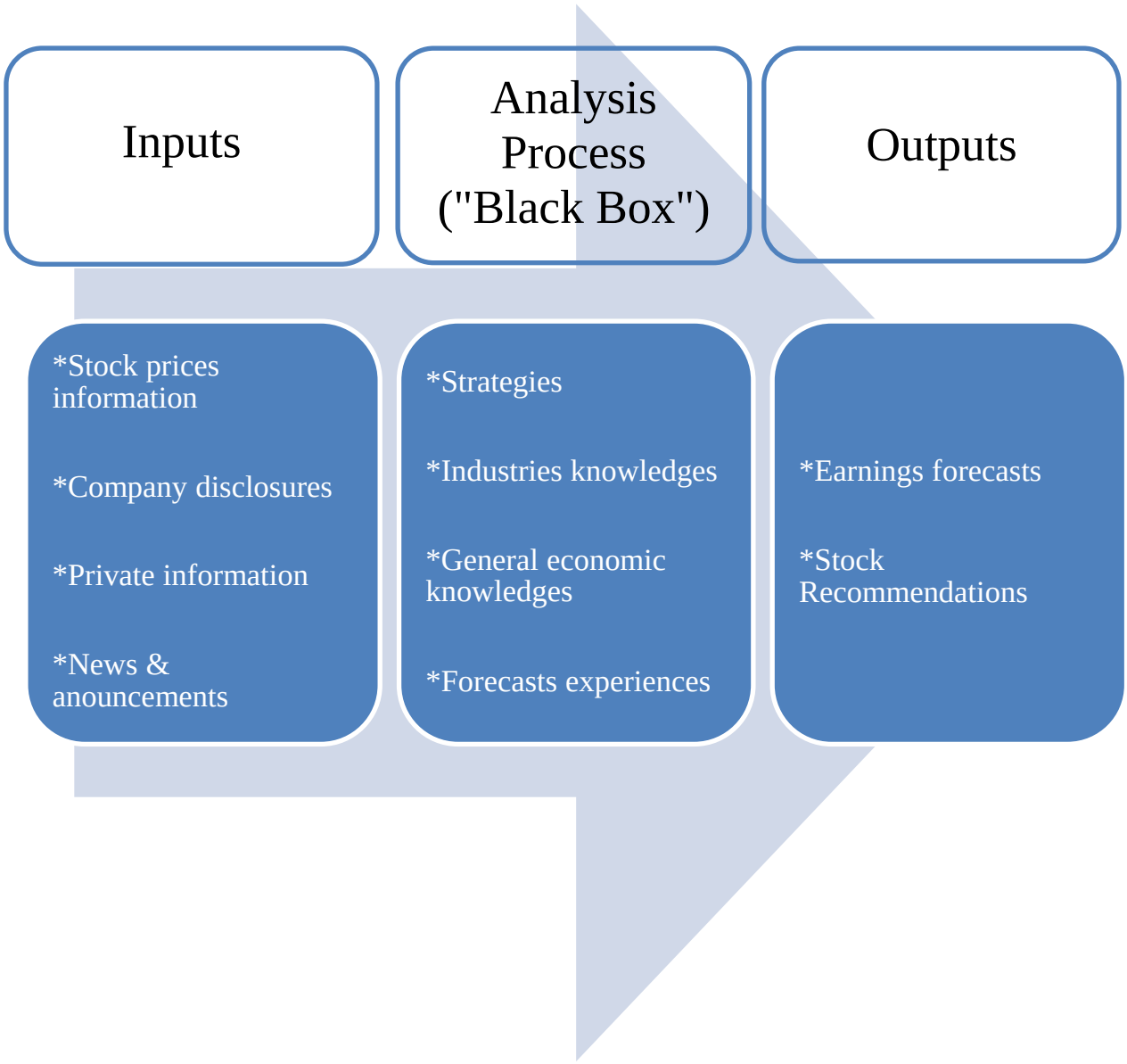
Analysts' forecast process

As mentioned above, even though analysts are able to gather more information than time-series models, they are only slightly better forecasters than the models. Because of this, researchers are curious to know whether the additional information analysts have is useful in the forecast process. Is this additional information fully used by analysts to generate forecasts? If yes, why do analysts not perform significantly better than time-series models? These questions require an examination of analysts' forecast process to solve.

Besides that, some researchers such as Bradshaw (2011), Ramnath, Rock & Shane (2008), and Schipper (1991) assume that there might occurs certain factors that have an influence on analysts' forecast process. Those factors include that analysts face conflicts of interest, which affect the way they use to generate forecasts and offer stock recommendations. Moreover, analysts' forecasts process generates bias, like the cases with optimistic earnings forecasts and stock recommendations we discussed previously. Therefore, questions regarding forecasts bias have been raised, inquiring topics like why analysts' forecasts tend to be optimistic. Does an analyst do this to please managers so that they would be able to maintain a consistent relationship with managers? All of those questions require an examination of analysts' forecast process to get answers.

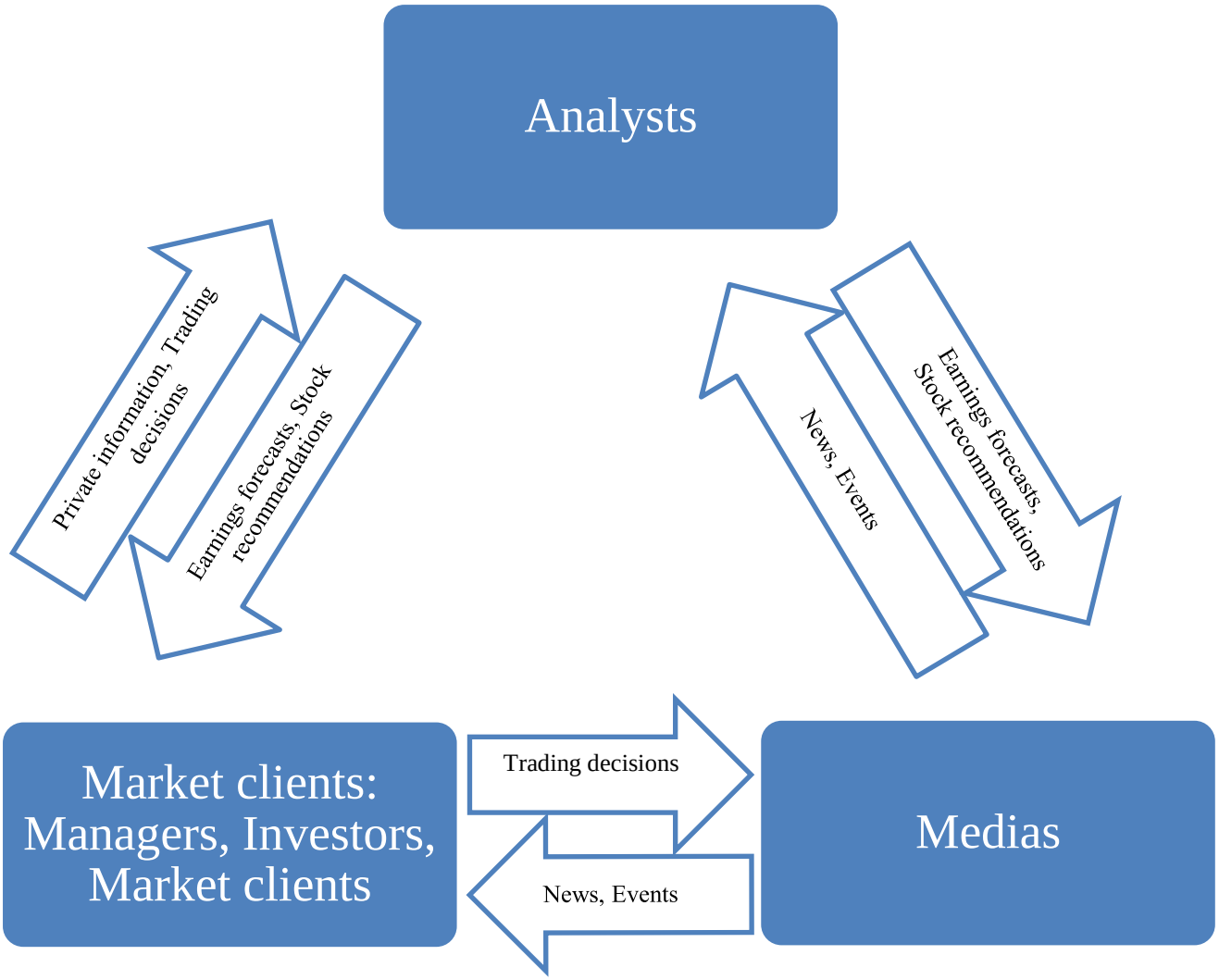
In fact, analysts' forecasts process involves studying what strategies and information analysts use to make forecasts, and what affects analysts' decisions in forecasts and stock recommendations. Since the biggest part of this process remains hidden, researchers refer to this process as a "black box" that requires further study. According to Schipper (1991), analysts' forecast process is a complex process. Analysts' earnings forecasts are only a portion within this process. The ultimate goal of this process is to provide stock recommendations to their clients. These recommendations include which stocks to buy, which stocks to sell, and which stocks to hold. The purpose of generating earnings forecasts is to evaluate the expected future return of each stock. Figures 1a and 1b on the following page provide us with a brief view of analysts' forecasts process.

Figure 1a Analysts' forecast process



Analysts use information listed in the left column as inputs to combine with their strategies, knowledge, and experiences to generate earnings forecasts and stock recommendations, which are considered as outputs from the analysts' forecast process. The analysis process is the "black box."

Figure 1b Analysts' forecast transaction process



The three groups are interconnected, as they interact each other in a multitude of ways. Analysts transfer their earnings forecasts and stock recommendations to both market clients and the media; analysts also receive information from market clients and the media to help generate forecasts. Likewise, market clients transfer information to both analysts and the media; they also receive information from analysts and the media for making trading decisions. The media, on the other hand, receive and report information from and to both market clients and analysts.

Indirect approach

According to Schipper (1991), analysts have an incentive to affect investors' reaction in replying to the stock recommendations they offered. Based on this, we can make a hypothesis that analysts tend to generate biased earnings forecasts to convince investors to follow their stock recommendations. For example, analysts might forecast higher earnings when they offer "Buy" recommendation and forecast lower when their recommendation is "Sell." Numerous studies have used correlational research to examine whether analysts' earnings forecasts and stock recommendations affect stock prices. Conversely, they have also surveyed whether changes and news in stock prices affect analysts' earnings forecasts and stock recommendations. Schipper (1991) found that previous studies examine a positive relationship between analysts' earnings forecasts and stock prices; an increase in a company's earnings forecasts increases that company's stock price. However, Schipper argues that the use of statistical examination is not sufficient to draw conclusions on whether analysts' incentives affect forecasts. Because it is possible that analysts try to positively affect companies' stock prices for the sake of maintaining a good relationship with managers in order to get more private information from managers or analysts might feel pressure from their employer to generate biased forecasts. Schipper states that "understanding analysts' incentives in forecasting earnings requires placing the forecasting task within the context of what the analyst does." According to Schipper, study that directly observes analysts' forecast process is necessary to examine how analysts' incentives affect analysts' forecasts.

Many studies have attempted to determine the factors that affect analysts' forecast accuracy. Most of these studies examine the correlations between analysts' forecast accuracy and analyst characteristics, which researchers consider may influence analysts' forecast accuracy. Myers, Omer & Shelley (2011), Groysberg, Healy, Nohria & Serafeim (2011), and Brown (2001) conclude that analysts' forecast accuracy are affected by observable analyst characteristics such as company-specific and general experience, size of brokerage house, past accuracy, number of industries, and number of companies followed. Myers, Omer & Shelley (2011), Groysberg, Healy, Nohria & Serafeim (2011), Brown (2001) report that analysts' forecast accuracy is positively associated with company-specific and general experience, size of brokerage house, and past accuracy. However, it was found to be negatively associated with number of industries and companies followed.

According to Schipper (1991), researchers investigate analysts and brokerage firms they work with and find that managers of publicly-traded companies tend to cooperate with analysts that had followed and generated forecasts for their company before. Based on this investigation, researchers assume that analysts who have more forecasts experience with a specific company are able to get more information that is private from managers, thus making their stock recommendations more profitable. Based on this assumption, researchers examine the relationship between number of years of analysts' forecasts experience with a specific company and the analysts' stock recommendations profitability. The test results show a positive relationship between the two variables: more experience associates with higher profitability; however, the relationship is not strong. Because of this, researchers cannot draw a strong conclusion

on the assumption. Since researchers did not directly observe whether managers provide more information to analysts with more forecasts experience with their company, they used statistical tests to examine the relationship, this kind of approach is referred to as an indirect approach used to study analysts' forecasts process. Since this approach does not provide enough evidence for researchers to draw conclusion on the information that analysts are able to get from managers in making forecasts, it is necessary for researchers to use a different approach, such as interviewing or surveying analysts for direct observation. In this project, we consider this type of approach to as a direct approach used to study analysts' forecasts process.

Direct Approach

There are several ways a researcher can adopt to directly study analysts' forecast process. They include administering surveys, laboratory experiments, and interviews. However, few studies have attempted to use such direct approach to observe analysts' forecast process. Block's (1999) survey study is one of those few studied that can be found. He surveyed members of the Association for Investment Management and Research (AIMR) regarding their uses of valuation models, importance of financial inputs, and bases for recommendations. As results of the surveys, he found that analysts rarely consider dividend policy when making stock recommendations. He also found that analysts' forecasts usually focus more on companies' long-term prospects when making stock recommendations.

Michael, Glover & Kennedy (2006) conducted a laboratory experiment to study how analysts' incentives affect their forecasts. They invited participants to participate in different forecast tasks that they designed and controlled. As results of this experiment, Michael, Glover & Kennedy (2006) found that without interaction of managers and analysts' employer, analysts' earnings forecasts are still optimistic when the recommendation is "Buy" and that analysts' earnings forecasts tend to be lower than actual earnings when the recommendation is "Sell." Because of this, Michael, Glover & Kennedy (2006) concludes that analysts have incentive to generate forecast bias to affect investors' trading decisions.

As we can see, studies using direct approach are able to provide us with more helpful information in studying analysts' forecasts that we cannot get from using an indirect approach. Those information can help us to address issues such as how do analysts use financial information to generate forecasts and stock recommendations; how does analysts' incentive affects forecasts and stock recommendation. However, we still need to consider limitations that the direct approach has. For example, the response bias (analysts do not tell the truth) and non-response bias (analysts do not answer/return the survey) are major concerns for survey studies. In addition, geographic limitations (researchers are not able to survey/interview analysts of different locations) of using a direct method can affect the extent to which the conclusion is representative. Furthermore, we did not find any study that uses interview as a method to examine the forecast process. The possible explanation of having no researcher uses this method is that the costs of interviewing analysts are too high for researchers to afford. In addition, interviewing analysts is a complex and time-consuming process. Besides that, it is

difficult to find analysts that are willing to cooperate with researchers to go through the interview process.

Conclusion/Discussion

In conclusion, we have learned a lot about analysts' forecast process. We are now able to differentiate the indirect and direct approaches used to study analysts' forecast process. We also addressed the advantages and limitations associated with both indirect and direct approaches. As results of our study, we conclude that both approaches are helpful in examining analysts' forecast process and are required for studying analysts' forecast process; using only one of the two approaches is not enough for us to have a clear understand of analysts' forecast process.

To date, researchers have conducted a considerable amount of studies with an indirect approach. Researchers are encouraged to switch their focuses to the use of direct approach in examining analysts' forecast process. For those that are going to directly observe analysts' forecast process, a few more methods that have not yet been practiced may be considered. They are include: locating information from analysts' TV shows, analysts' presentations, and analysts' autobiographies; and interviewing analysts regarding their decision making process. In particular, any effort from researchers into improving the limitations that previous studies have encountered, such as geographic concerns, is strongly encouraged.

Furthermore, the hypothesis of which sell-side analysts, who are facing more conflicts of interest than buy-side analysts, make more biased stock recommendations still remain unproved. Issues concerning bias also need to be addressed in future studies. Any information from future examinations of using a direct approach that help addresses those unsolved areas would increase our understanding of analysts' forecasts as well as the capital market, which may eventually contributed to the improvement of a more efficient capital market.

References

Lin, H., & McNichols, M. F. (1998). Underwriting relationships, analysts' earnings forecasts and investment recommendations. *Journal of Accounting and Economics*, *25*(1), 101-127.

Keskek, S., Myers, L. A., Omer, T. C., & Shelley, M. (2011). A re-examination of the importance of analyst and forecast characteristics for forecast accuracy: The effects of analyst disagreement, stale forecasts, and the information environment. *SSRN*. Retrieved June 1, 2012 from http://ssrn.com/abstract=1809200

Ramnath, S., Rock, S., & Shane, P. (2008). A review of research related to financial analysts' forecasts and stock recommendations. *SSRN*. Retrieved June 1, 2012 from http://ssrn.com/abstract=848248

Hilary, G., & Hsu, C. (2012). Analyst forecast consistency. *Journal of Finance, Forthcoming*. Retrieved June 1, 2012 from http://ssrn.com/abstract=1988919

Bradshaw, M. T. (2011). Analysts' forecasts: What do we know after decades of work? *SSRN*. Retrieved June 1, 2012 from http://ssrn.com/abstract=1880339

Groysberg, B., Healy, P., Chapman, C., Shanthikumar, D., & Gui, Y. (2007). Do buy-side analysts out-perform the sell-side? *SSRN*. Retrieved June 1, 2012 from http://ssrn.com/abstract=806264

Schipper, K. (1991).Commentary on analysts' forecasts. *Accounting Horizons*, *5*(4), 105-121.

Lapide, L. (2007). Don't just measure forecast errors. *The Journal of Business Forecasting*, *26*(2), 16-18.

Brown, L. D. (2001). How important is past analyst forecast accuracy? *Financial Analysts Journal*, *57*(6), 44-49.

Bradley, D. J., Jordan, B. D., & Ritter, J. R. (2005). Analyst behavior following IPOs: The "bubble period" evidence. *SSRN*. Retrieved June 1, 2012 from http://ssrn.com/abstract=758388

Fang, L., & Yasuda, A. (2005). Reputation as discipline in sell-side research. *Working Paper*. Retrieved June 1, 2012 from http://www.uic.edu/cba/cba-depts/finance/documents/seminar10072005.pdf

Skinner, D. J. (1994). Why firms voluntarily disclose bad news. *Journal of Accounting Research*, *32*(1), 38-60.

Desalvo, J. S. (1971). Standard error of forecast in multiple regression: Proof of a useful result. *The American Statistician*, *25*(4), 32-34.

Ramnath, S., Rock, S., & Shane, P. B. (2008). The financial analyst forecasting literature: A taxonomy with suggestions for further research. *International Journal of Forecasting*, *24*(1), 34-75.

Beyer, A., Cohen, D. A., Lys, T. Z., & Walther, B. R. (2010). The financial reporting environment: Review of the recent literature. *Journal of Accounting and Economics*, *50*(2-3), 296-343.

Groysberg, B., Healy, P., Nohria, N., & Serafeim, G. (2011). What factors drive analyst forecasts? *Financial Analysts Journal*, *67*(4), 18-29.

Mirror, Mirror, In the Eyes: Mental State Decoding Abilities in Pathological Narcissism

Neil A. Meyer
The Pennsylvania State University

McNair Faculty Research Advisor:
Kenneth N. Levy, Ph.D.
Associate Professor of Clinical Psychology
Department of Psychology
College of the Liberal Arts
The Pennsylvania State University

Abstract

Objective: This study sought to examine the relationship between pathological narcissism and mental state decoding abilities. **Methods:** 145 undergraduate students participated in a laboratory experiment for course credit. Narcissism was assessed with the Pathological Narcissism Inventory (PNI) and mental state decoding abilities were assessed with the Reading the Mind in the Eyes (RME) task. **Procedure:** Participants were presented with photographs of human faces on a computer screen, and were asked to pair words to the photographs, which were cropped to the eye region of the face. The valence of each face was categorized as positive, negative, and neutral. **Hypotheses:** It was hypothesized that a negative correlation would be observed in the relationship between the PNI and the RME, such that higher levels of narcissism would be associated with decreased levels in mental state decoding accuracy. It was also hypothesized that a positive correlation existed in the PNI and in RME targets of positive valence, such that higher levels of narcissism would be associated with increased mental state decoding abilities in targets of positive valence. **Results:** Both hypotheses were not supported; however, a statistically significant quadratic relationship was found between the PNI and the RME, such that higher and lower levels of narcissism were associated with decreases in mental state decoding abilities, with moderate levels of narcissism associated with higher RME scores.

Mirror, Mirror, In the Eyes: Mental State Decoding Abilities in Pathological Narcissism

Our modern interpretation of narcissism can be traced back to Narcissus of Greek mythology—a man who fell in love with his own reflection, disregarding all others, until his untimely death. As a construct, narcissism can be defined dimensionally (e.g., low to high levels of narcissism) and categorically (e.g., as a person who is narcissistic). The inability to empathize with other people—whether by choice, skill, or any combination of the two—is a hallmark of Narcissistic Personality Disorder (NPD) (for a review, see Carlson, Vazire, & Oltmanns, 2011). In the absence of empathy, the quality of a one's personal, professional, and familial lives, tend to suffer (Byron, 2007). According to the Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.; DSM–IV–TR; APA, 2000), symptoms of the disorder include pervasive thoughts or fantasies of an idealized self, an unreasonable sense of entitlement over others, and haughty or arrogant behavior. Narcissists also tend to share the belief that their lives, opinions,

and thoughts are in a category all their own. People who suffer from NPD are also often willing to use or manipulate other people in a way that is advantageous to their own pursuits, disregarding the wellbeing of others. Across NPD symptomatology, interpersonal functioning deficits in particular are most severe (e.g., Magidson et al., 2012; Miller, Campbell, & Pilkonis, 2007; Ogrodniczuk et al., 2009), often resulting in many failed relationships (Kernberg, 1976; Kohut, 1984), with some citing concerns for increased risk of suicide (e.g., Kernberg, 1984; Magidson et al., 2012; Links, Gould, & Ratnayake, 2003; Ronningstam & Maltsberger, 1998; Ronningstam, Weinberg, & Maltsberger, 2008). Reports on the prevalence of narcissism as a personality disorder range from 0% to 6% in communities (APA, 2000; Ritter, 2011; Stinson et al., 2008), with higher rates of clinical prevalence, estimated to range from 2% to 16% (APA, 2000). Additionally, patients diagnosed with NPD accounted for 84% of those disciplined in the military, while narcissism in CEOs was found to be related to unstable performance (Chatterjee & Hambrick, 2007).

Historically, narcissism as a personality disorder was not a viable diagnosis for practicing clinicians until 1980, when a portrait of NPD was articulated within the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III). At present, much discussion exists within the literature about the future of narcissism. Some have argued that since the publication of the DSM-III, clinicians have faced diagnostic challenges, particularly when dealing with the disparities between the characteristics of their clinically distressed narcissistic patients and an inadequate match of their symptomatology to DSM criteria (Cain, Pincus, & Ansell, 2008; Gabbard, 1989; Gunderson, Ronningstam, & Smith, 1991; Levy, Reynoso, Wasserman, & Clarkin, 2007). Some have also argued that the elimination of certain criteria in subsequent editions of the DSM were due in large part to concerns over comorbidity with other personality disorders (Levy, Ellison, & Reynoso, 2011). Amid growing concerns regarding the dramatic changes posed by the DSM-5 committee, including the recently discarded plan to remove NPD from the latest edition of the manual (Pies, 2011), the results of one study (Zimmerman, Chelminski, Young, Dalrymple, & Martinez, 2012) argued that such an omission could have wrongfully resulted in the absence of diagnoses for a small but significant subset of patients (i.e., false-negative diagnoses).

To better articulate narcissism, clinical scholars have posed two subtypes. Like two sides of a mirror, the two sides of narcissism are known as narcissistic grandiosity and narcissistic vulnerability (e.g., Akhtar & Thomson, 1982; Cain et al., 2008; Gabbard, 1989; 1998; Gersten, 1991; Kernberg, 1967; 1984; Kohut & Wolf, 1978; Levy et al., 2007; 2011; 2012; Pincus & Lukowitsky, 2010). Grandiose narcissism can be characterized by arrogance, exploitativeness, lack of empathy, having minimal anxiety, and being envious of others (or believing that others are envious of you) (Levy, 2012). Although the grandiose narcissistic symptomatology is better in sync with current DSM-IV-TR criteria, someone in a state of grandiose narcissism tends to appear less frequently in the clinical setting. In contrast, the vulnerable manifestation of narcissism is largely absent from the DSM-IV, but prevalent in the clinical setting (Pincus et al., 2009). The vulnerable state of narcissism can both endure and inflict suffering; this is often implemented by provoking others to react to their psychological pain. They experience bouts of rage, can be quite irritating to others, and can be verbally abusive (Pies, 2011). As such, their levels of distress are significantly more visible to clinicians than that of a grandiose narcissist (Pincus et al., 2009).

Pincus et al., (2009) argued that the clinic to research disparity of NPD was a direct result of measures that failed to account for its multi-dimensional characteristics. They further argued that, despite the large research body on the two-sided nature of narcissism, the majority of researchers have continued to use measures derived from the DSM's one-dimensional grandiose-themed NPD criteria. This statement is highly congruent with the clinical literature when examining the populous Narcissistic Personality Inventory (NPI). For over 30 years, the NPI has been one of few industry standard measures for narcissism; in fact, since 1985, in 77% of research conducted on narcissism in social or personality psychology, the NPI was used as the only or a primary measure for narcissism (Cain, Pincus, & Ansell, 2008). Ultimately, the inadequacy of these measures necessitated the development of the Pathological Narcissism Inventory (PNI) (Pincus et al., 2009), which is used in the current study.

Despite the large and diverse literature on narcissism as a construct—as a personality disorder, it has the least empirical support of the other 9 personality disorders in the DSM-IV (Stinson et al. 2008). Similarly, empathic deficits in narcissism have also received little empirical attention in research (South, Eaton, & Krueger, 2011). From a perspective based in theory, clinical scholars have published many writings hypothesizing why narcissistic individuals exhibit deficits in empathy (Dimaggio et al. 2002; Gabbard, 1989; Kernberg, 1967; Kohut, 1966; Moeller, Robinson, Wilkowski, & Hanson, 2012). To briefly define the construct, empathy can be described as the ability to decode and experience the cognitive and emotional states of others, while simultaneously reflecting on one's internalized response to them (Decety & Moriguchi, 2007). Most research examining empathy in narcissism has used self-report measures for empathy; however, social desirability bias (Fisher, 1993)—defined as the tendency for participants to answer questions in favorable ways—may result when using these measures. This effect may become compounded within the narcissistic individual's personality, as clinical theory would suggest that they might exaggerate, overestimate, or otherwise inflate their empathic abilities, more so than someone who is not pathologically distressed. In contrast to the social desirability bias, other internal biases may also be at work, leading the narcissistic individual to downplay their empathic abilities for any number of reasons, including the belief that they are uninterested or bored by the minutia of interpersonal structures. Interestingly, a new thread of research suggests that narcissists are not as out of touch with interpersonal structures as once thought (Carlson, Vazire, & Furr, 2011); however, many clinical theorists suggest otherwise (Benjamin, 1993; Dimaggio et al. 2002; Gabbard, 1989; Kernberg, 1967; Kohut, 1966; Moeller, Robinson, Wilkowski, & Hanson, 2012). Thus, additional empirical research on empathy is needed, as well as a tool of measurement with greater precision.

The Reading the Mind in the Eyes (RME) task (Baron-Cohen et al., 2001) attempts to measure components of empathy, by gauging one's ability to decode the mental states of others. It is also a task that can be evaluated empirically. In it, participants are presented with photographs of faces that are cropped from the nose to the eyebrow region, along with four words, all of similar valence (to reduce ceiling effects). The task has proven to be valid across several studies, with significant differences being reported across samples of clinically distressed patients. In women with major depressive disorder, significant deficits in RME accuracy were found (Lee, Harkness, Sabbagh, & Jacobson, 2005), and in people with borderline personality disorder (BPD), increases in both overall RME accuracy (Fertuck et al., 2009) and negative RME accuracy were reported (Scott, Levy, Adams Jr. & Stevenson, 2011).

In the current study, the relationship between pathological narcissism and mental state decoding is evaluated, using the PNI as a measure for components of narcissism, and the Reading the Mind in the Eyes task as a measure for mental state decoding. The first research hypothesis is that a negative correlation will be observed in the relationship between overall PNI scores and the overall RME accuracy, such higher levels of narcissism narcissistic traits will be associated with lower levels of mental state decoding accuracy. The second research hypothesis is that a positive correlation will be observed in overall PNI scores and RME targets of positive valence, such that an higher levels of narcissism will associate with higher accuracy in decoding mental states from photos of positive valence.

Methods

Participants

Undergraduate students (*N* = 145) from a large northeastern U.S. university voluntarily participated for credit as part of their introductory psychology course. Two participants were excluded from the final sample due to invalid responses on the PNI measure, as well as 13 other participants who strongly disagreed to the statement "I have answered all of these questions to the best of my ability." Within the sample of 130, the average age of participants was 18.99 (*SD* = 1.54, range = 18 – 32) with males accounting for 37% of participants, and females, 63%. The ethnicity of participants in the final sample was predominantly Caucasian (73%), followed by Asian (9.5%), Hispanic (7.9%) and African American (4.8%).

Measures

The Pathological Narcissism Inventory (PNI; Pincus et al., 2009) is a 52 item self-report questionnaire that contains 7 subscales: contingent self-esteem (CSE), exploitativeness (EXP), self-sacrificing self-enhancement (SSSE), hiding the self (HS), grandiose fantasy (GF), devaluing (DEV), and entitlement rage (ER). Each item is rated using a 0 to 6 Likert-Scale (0 = "Not At All Like Me," and 6 = "Very Much Like Me"). Sample items include: "I often fantasize about being admired and respected," and "I can get pretty angry when others disagree with me." The EXP, SSSE, and GF subscales are averaged to an overall narcissistic grandiosity score, and specific items in the CSE, HS, DEV, and ER subscales are averaged for a narcissistic vulnerability score. An average of all 52 items results in a total PNI score.

Reading the Mind in the Eyes. The Reading the Mind in the Eyes (RME; Baron-Cohen et al., 2001) task is a computer program that is designed to measure one's ability to decode emotional states from photographs of the human face, particularly, the eye region of the face area (i.e., the area above the bridge of the nose and below the brow line). Each photograph has been cropped to the same size. Before each trial, a white background with a centered fixation cross is presented on the computer screen, immediately after which a centered photograph is displayed. At each of the 4 corners, 4 different words are presented; 3 of which are incorrect, 1 of which is the correct target. The computerized task presents a different randomized set each time, consisting of 36 different photographs, of which all are in grayscale (i.e., shades of black and white). Before the task begins, the following instructions appear onscreen:

You will see a series of photographs of faces. Your task is to decide what each person is thinking or feeling. For each face, enter the number on the keyboard that corresponds with the number of the word that best describes what the person in the photograph is thinking or feeling. You may feel that more than one word is applicable, but please just choose one word which you consider to be the most suitable. Before making your choice, make sure that you have read all 4 words.

Performance on the RME task was electronically recorded in the E-Prime 2.0 software. Within the RME task, targets were split into 3 different categories of valence: positive, negative, and neutral. This study derived recently developed criteria (see Scott et al., 2011) for both image and word valence, which resulted in a total of 36 targets: 9 of which were positive, 10 of which were negative, and 17 of which were neutral.

Procedures

Participants were bought into the laboratory setting in groups ranging from 1 to 4 (M = 3.43, SD = .79). Each participant was randomly assigned to a computer station, where they were seated throughout the duration of the study. Each computer had been previously set up by the proctor, prior to the arrival of the participants, and spacing between each station was such that participants were not able to easily view their cohort's screen. Participants then were asked to listen to the proctor read from a script, which provided them with a brief description of the study. After participants were provided with this description, they were given the option to discontinue at any time; however, if they chose to proceed, they were asked to review and sign a document of consent. In this study, all participants willingly provided written consent. Next, they were asked to fill out a series of measures, including a demographics questionnaire and the PNI. After each individual within that group of participants had completed the measures, the proctor instructed participants to follow the instructions on their station's computer screen. After completing the computerized task, participants were debriefed and given standard IRB-approved debriefing forms, which provided them with the primary investigator's contact information. They were also provided with information on local counseling services that were available, in the event that they had any feelings of distress from participating in the study. After this point, the participants were dismissed.

Results

All analyses were conducted using the Statistical Package for the Social Sciences, version 20 (SPSS 20). The independent variables were scores on the 7 PNI subscales (CSE, EXP, SSSE, GF, HS, DEV, and ER), their aggregate totals forming two factors (Narcissistic Grandiosity and Narcissistic Vulnerability), and the mean PNI score overall. The dependent variables were RME accuracy scores of positive valence, negative valence, neutral valance, and RME accuracy overall (i.e., across valences).

Preliminary Analyses. Several statistical analyses were conducted first, including descriptive and frequency reports of the data.

Frequencies. Frequencies showed 2 participants with responses on the PNI that were outside the scope of acceptable answers (e.g., an 8 when the highest response is a 6) which led to their exclusion from the final sample. Mean RME and PNI scores and their respective standard deviations (across genders) are available for review (see *Table 1*).

Relationship between PNI factors and subscales. Pearson correlational analyses were run on for all independent variables. Most components of the PNI were significantly correlated with each other ($p < .05$). with the exception of the CSE, SSSE, and DEV subscales, which were not significantly correlated to the EXP subscale ($p > .05$) Additionally, a Pearson correlation examining the EXP subscale and the Narcissistic Vulnerability factor were also not significantly related ($p > .05$). Results from a Pearson correlation on Narcissistic Grandiosity and Narcissistic Vulnerability factor, showed a moderate and highly significant correlation ($r = .435$, $p < .000$).

Relationship between RME targets. Next, Pearson correlations were conducted on the valence of RME targets: positive and negative accuracy scores ($r = .262$, $p = .003$), negative and neutral accuracy scores ($r = .287$, $p = .001$), and neutral and positive accuracy scores ($r = .261$, $p = .003$).

Demographic differences. Next we examined the relationship between demographic variables such as age, gender, and ethnicity, and the independent (PNI scores) and dependent variables (e.g., RME targets). Gender was not found to be a related to RME performance. Results from a t-test demonstrated a significant difference in RME scores between men ($M = .688$, $SD = .109$) and women ($M = .729$, $SD = .098$); $t(125) = -2.171$, $p = .032$. This sex difference appears to be synonymous with a trend reported by Baron-Cohen et al. (2001).

Primary analyses. We examined the relationship between PNI scores and RME accuracy using Pearson correlations. Contrary to our first hypothesis, no significant linear relationships between the two measures were found (see *Figure 2*, $R^2 = .000$, $F(1, 128) = .010$, $p = .922$), including analyses which examined the PNI and its relationship to negative RME targets (see *Figure 3*, $R^2 = .000$, $F(1, 128) = .012$, $p = .912$), neutral RME targets (see *Figure 4*, $R^2 = .003$, $F(1, 128) = .374$, $p = .542$), and positive RME targets (see *Figure 5*, $R^2 = .011$, $F(1, 128) = 1.484$, $p = .225$). Further, upon closer inspection of a scatterplot comprised of RME and PNI scores, a curvilinear relationship appeared to be present (see *Figure 6*); thus, a non-linear regression analysis was conducted, wherein a highly statistically significant quadratic relationship was found, such that lower and higher PNI scores predict lower overall RME accuracy, $R^2 = .063$, $F(2, 127) = 4.281$, $p = .016$.

Discussion

Empathy deficits have long been considered to be a hallmark of Narcissistic Personality Disorder (NPD) (for a review, see Carlson, Vazire, & Oltmanns, 2011). These deficits can reduce the quality of one's life in profound ways (Byron, 2007). Conceptualizations of pathological narcissism can be defined dimensionally (e.g., low and high levels of narcissism), and categorically (e.g., NPD). People who suffer from NPD have significant difficulties across their interpersonal functioning (e.g., Magidson et al., 2012; Miller, Campbell, & Pilkonis, 2007;

Ogrodniczuk et al., 2009), often leading to many failed relationships (Kernberg, 1976; Kohut, 1984), and increases in suicidality (e.g., Kernberg, 1984; Magidson et al., 2012; Links, Gould, & Ratnayake, 2003; Ronningstam & Maltsberger, 1998; Ronningstam, Weinberg, & Maltsberger, 2008).

The results of this study partially aligned with the first reported hypothesis (i.e., higher levels of narcissism predict lower RME scores) such higher levels of pathologically narcissism correlate with lower levels of RME accuracy. However, this study's findings also show that RME accuracy can be predicted by decreases in pathological narcissism—a finding that was not hypothesized. At first glance, these findings may not appear to be in agreement with current clinical theories; however, people who are low in self-esteem—but not necessarily low in narcissism—may be misrepresented on the PNI as having low levels of pathological narcissism. Similarly, having low self-esteem may underestimate one's ability to participate, and, subsequently, have a lower score on the RME task. It is also possible that those scoring low on the PNI are actually responding defensively (i.e., they are reporting low levels of narcissism despite being high in it). Some research suggests that people who respond extremely lowly on self-report measures are often responding defensively and could be among the most disturbed. The opposite finding in this study—that higher levels of pathological narcissism result in lower mental state decoding accuracy—appears to be in agreement with our first hypothesis, in addition to theoretical descriptions of narcissism (Dimaggio et al. 2002; Gabbard, 1989; Kernberg, 1967; Kohut, 1966; Moeller, Robinson, Wilkowski, & Hanson, 2012).

The second hypothesis was that narcissistic individuals are more likely to be able to accurately decode mental states of friendly faces (i.e., in photographs of eyes of positive valence). By manufacturing a persona of manipulation and exploitation, it would appear to be congruent with the literature to hypothesize that the narcissistic individual has an increased ability to accurately distinguish friendly faces, as this ability may lead to relations with others where their self-image stands to gain. Contrary to this hypothesis, however, no correlations between positive RME stimuli and increases in pathological narcissism were found.

Although the PNI appears to be gaining traction within the scholarly community, a potential limitation with the study is that the measure is a sub-clinical scale, and thus is incapable of diagnosing an individual with NPD (Pincus et al., 2009); however, this study was more focused on implications of dimensional narcissism than categorical definitions. Additionally, although this study sought to represent ethnicity fairly, the ethnicities of the participants used in this study's sample were predominantly Caucasian. One study suggests an intracultural advantage between Japanese and American students when given a culture-specific version of the RME task (Adams et al., 2010) Thus, it could be argued that, because the ethnicities of the participants in our sample were predominantly Caucasian, and because the people in the photographs were also Caucasian, our results may be more valid. Ultimately, however, our sample showed no significant differences in PNI and RME scores when examining Caucasians against non-Caucasians, and Asians against non-Asians. Another limitation of the study pertains to an item regarding a participant's honesty, which was added at a later time. As such, of the 130 participants, less than 30 were given the item "I have answered all of these questions honestly." Thus, those responses were ignored across the board, to maintain consistency with the rest of the sample. Another limitation to this study involves the possibility of another variable existing that was unmeasured and responsible for the significant quadratic relationship in PNI and RME scores. Lastly, the PNI and other personality disorder self-report measures tend to cast a wider

net of diagnostic criteria than necessary, meaning that more people who are not necessarily pathologically narcissistic could still potentially score in higher PNI ranges; however, in spite of this, the PNI has shown significantly more promise than its alternatives at effectively pointing out narcissistic individuals in both vulnerable and grandiose states thus far (Maxwell, Donnellan, Hopwood, & Ackerman, 2011; Pincus et al., 2009). Ultimately, both the PNI and the RME were found to be internally valid measures, further strengthening this study's conclusions.

Several implications can be derived from this study by examining the dimensionality of narcissism, as opposed to the rigidity of categorization. This study suggests that mental state decoding abilities and deficiencies lie on a continuum of narcissistic pathology. This study also suggests that clinical scholars have been largely successful in articulating deficits in empathy as a component of narcissism. It is recommended that additional studies be conducted to empirically examine empathy in narcissism using different methodologies and measures. Other areas of recommended future study include comparisons of dimensional narcissism (as measured with the PNI) to categorical NPD diagnoses. Such a study may shed new light on their differences and their efficacy.

Narcissism affects the lives of people in profoundly negative ways. It interferes with one's capacity to develop close intimate relationships and to enjoy one's accomplishments. A lack of concern for others and an over concern with oneself is a central characteristic of those high in narcissism. Although narcissism does not appear to be linearly related to mental state decoding, the current study's findings suggest high levels of narcissism is related one's ability to decode the mental states of others. This lends new empirical support to earlier clinical theories posited by Kernberg, Kohut, and other clinical scholars. Future research should examine the links between these deficits in mental state decoding and difficulties in relationship and work functioning so characteristic of narcissistic individuals.

References

Adams, J., Rule, N. O., Franklin, J., Wang, E., Stevenson, M. T., Yoshikawa, S., Nomura, M., et al. (2010). Cross-cultural Reading the Mind in the Eyes: An fMRI Investigation. *Journal of Cognitive Neuroscience*, *22*(1), 97–108.

Akhtar, S., & Thomson, J. A., Jr. (1982). Overview: narcissistic personality disorder. *The American journal of psychiatry*, *139*(1), 12–20.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). doi:10.1176/appi.books.9780890423349.

Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "Reading the Mind in the Eyes" Test Revised Version: A Study with Normal Adults, and Adults with Asperger Syndrome or High-functioning Autism. *Journal of Child Psychology and Psychiatry*, *42*(2), 241–251. doi:10.1111/1469-7610.00715

Byron, K. (2007). Male and female managers' ability to read emotions: Relationships with supervisor's performance ratings and subordinates' satisfaction ratings. *Journal of Occupational and Organizational Psychology*, *80*(4), 713–733. doi:10.1348/096317907X174349

Cain, N. M., Pincus, A. L., & Ansell, E. B. (2008). Narcissism at the crossroads: Phenotypic description of pathological narcissism across clinical theory, social/personality psychology, and psychiatric diagnosis. *Clinical Psychology Review*, *28*(4), 638–656. doi:10.1016/j.cpr.2007.09.006

Carlson, E. N., Vazire, S., & Furr, R. M. (2011). Meta-insight: Do people really know how others see them? *Journal of personality and social psychology*, *101*(4), 831.

Carlson, E. N., Vazire, S., & Oltmanns, T. F. (2011). You probably think this papers about you: Narcissists perceptions of their personality and reputation. *Journal of Personality and Social Psychology*, *101*(1), 185-201. doi:10.1037/a0023781

Chatterjee, A., & Hambrick, D. C. (2007). It's all about me: narcissistic chief executive officers and their effects on company strategy and performance. *Administrative Science Quarterly*, *52*(3), 351–386. doi:10.2189/asqu.52.3.351

Decety, J., Moriguchi, Y. (2007). The empathic brain and its dysfunction in psychiatric populations: implications for intervention across different clinical conditions. *BioPsychoSocial Medicine*, *1*(1), 22.

Dimaggio, G., Semerari, A., Falcone, M., Nicolò, G., Carcione, A., & Procacci, M. (2002). Metacognition, states of mind, cognitive biases, and interpersonal cycles: Proposal for an integrated narcissism model. *Journal of Psychotherapy Integration*, *12*(4), 421–451. doi: 10.1037/1053-0479.12.4.421

Fertuck, E. A., Jekal, A., Song, I., Wyman, B., Morris, M. C., Wilson, S. T., Brodsky, B. S., et al. (2009). Enhanced "Reading the Mind in the Eyes" in borderline personality disorder compared to healthy controls. *Psychological Medicine*, *39*(12), 1979–1988. doi:10.1017/S003329170900600X

Fisher, R. J. (1993). Social Desirability Bias and the Validity of Indirect Questioning. *Journal of Consumer Research*, *20*(2), 303–315.

Gabbard, G. (1989). Two subtypes of narcissistic personality disorder. *Bulletin of the Menninger Clinic*, *53*(6), 527–532.

Gabbard, G. O. (1998). Transference and countertransference in the treatment of narcissistic patients. (E. F. Ronningstam, Ed.), 125–145.

Gersten, S. P. (1991). Narcissistic personality disorder consists of two distinct subtypes. *Psychiatric Times*, *8*, 25-26.

Gunderson, J. G., Ronningstam, E., & Smith L. E. (1991). Narcissistic personality disorder: A review of data on DSM- III- R descriptions. *Journal of Personality Disorders*, *5*, 167–178.

Kernberg, O. (1967). Borderline Personality Organization. *Journal of the American Psychoanalytic Association*, *15*(3), 641–685. doi:10.1177/000306516701500309

Kernberg, O. F. (1976). Technical considerations in the treatment of borderline personality organization. *Journal of the American Psychoanalytic Association*, *24*(4), 795–829. doi:http://dx.doi.org.ezaccess.libraries.psu.edu/10.1177/000306517602400403

Kernberg, O. (1984). *Severe Personality Disorders: Psychotherapeutic Strategies.* New Haven, Conn.: Yale Univ. Press.

Kohut, H. (1966). Forms and transformations of narcissism. *Journal of the American Psychoanalytic Association*, *14*(2), 243–272. doi:10.1177/000306516601400201

Kohut, H. (1984). Introspection, empathy, and semicircle of mental health. *Emotions & Behavior Monographs*, *Mo 3*, 347–375.

Kohut, H., & Wolf, E. (1978). The disorders of the self and their treatment: An outline. *The International Journal of Psychoanalysis*, *59*(4) 413—426

Lee, L., Harkness, K. L., Sabbagh, M. A., & Jacobson, J. A. (2005). Mental state decoding abilities in clinical depression. *Journal of Affective Disorders*, *86*(2–3), 247–258. doi:10.1016/j.jad.2005.02.007

Levy, K. N., Reynoso, J., Wasserman, R. H., & Clarkin, J. F. (2007). Narcissistic personality disorder. In W. O'Donohue, K. A. Fowler, & S. O. Lilienfeld (Eds.), *Personality Disorders: Toward the DSM- V* (pp. 233–277). Thousand Oaks, CA: Sage.

Levy, K. N., Ellison, W. D., & Reynoso, J. S. (2011). A historical review of narcissism and narcissistic personality. *The Handbook of Narcissism and Narcissistic Personality Disorder: Theoretical Approaches, Empirical Findings, and Treatments*, 1, 3–13.

Levy, K. N. (2012). Subtypes, dimensions, levels, and mental States in narcissism and narcissistic personality disorder. *Journal of clinical psychology*, *68*(8), 886–897. doi:10.1002/jclp.21893

Links, P. S., Gould, B., & Ratnayake, R. (2003). Assessing suicidal youth with antisocial, borderline, or narcissistic personality disorder. *Canadian Journal of Psychiatry*, *48*, 301–310.

Magidson, J. F., Collado-Rodriguez, A., Madan, A., Perez-Camoirano, N. A., Galloway, S. K., Borckardt, J. J., Campbell, W. K., et al. (2012). Addressing narcissistic personality features in the context of medical care: Integrating diverse perspectives to inform clinical practice. *Personality Disorders: Theory, Research, and Treatment*, *3*(2), 196–208. doi:10.1037/a0025854

Maxwell, K., Donnellan, M. B., Hopwood, C. J., & Ackerman, R. A. (2011). The two faces of Narcissus? An empirical comparison of the Narcissistic Personality Inventory and the Pathological Narcissism Inventory. *Personality and Individual Differences*, *50*(5), 577–582. doi:10.1016/j.paid.2010.11.031

Miller, J. D., Campbell, W. K., & Pilkonis, P. A. (2007). Narcissistic personality disorder: Relations with distress and functional impairment. *Comprehensive Psychiatry*, *48*, 170–177. doi:10.1016/j.comppsych.2006.10.003

Moeller, S. K., Robinson, M. D., Wilkowski, B. M., & Hanson, D. M. (2012). The Big Chill: Interpersonal Coldness and Emotion-Labeling Skills. *Journal of Personality*, *80*(3), 703–724. doi:10.1111/j.1467-6494.2011.00738.x

Ogrodniczuk, J., Piper, W., Joyce, A., Steinberg, P., & Duggal, S. (2009). Interpersonal problems associated with narcissism among psychiatric outpatients. *Journal of Psychiatric Research*, *43*, 837–842. doi:10.1016/j.jpsychires.2008.12.005

Pies, R. (2011). How To Eliminate Narcissism Overnight. *Innovations in Clinical Neuroscience*, *8*(2), 23–27.

Pincus, A. L., Ansell, E. B., Pimentel, C. A., Cain, N. M., Wright, A. G. C., & Levy, K. N. (2009). Initial construction and validation of the Pathological Narcissism Inventory. *Psychological Assessment*, *21*(3), 365–379. doi:10.1037/a0016530

Pincus, A.L., & Lukowitsky, M.R. (2010). Pathological Narcissism and Narcissistic Personality Disorder. *Annual Review of Clinical Psychology*, *6*, 421—446.

Ritter, K. (2011). Lack of empathy in patients with narcissistic personality disorder. *Psychiatry research*, 187(1-2), 241-247.doi:10.1016/j.psychres.2010.09.013

Ronningstam, E. F., & Maltsberger, J. T. (1998). Pathological narcissism and sudden suicide-related collapse. *Suicide and Life-Threatening Behavior*, *28*, 261–271.

Ronningstam, E., Weinberg, I., & Maltsberger, J. T. (2008). Eleven deaths of Mr. K: Contributing factors to suicide in narcissistic personalities. *Psychiatry*, *71*, 169–182.

South, S. C., Eaton, N. R., & Krueger, R. F. (2011). Narcissism in official psychiatric classification systems. In W. K. Campbell & J. D. Miller (Eds.), *The Handbook of Narcissism and Narcissistic Personality Disorder* (pp. 22–30). John Wiley & Sons, Inc.

Stinson, F. S., Dawson, D. A., Goldstein, R. B., Chou, S. P., Huang, B., Smith, S. M., Ruan, W. J., et al. (2008). Prevalence, correlates, disability, and comorbidity of DSM-IV narcissistic personality disorder: results from the wave 2 national epidemiologic survey on alcohol and related conditions. *The Journal of clinical psychiatry*, *69*(7), 1033–1045.

Zimmerman, M., Chelminski, I., Young, D., Dalrymple, K., & Martinez, J. (2012). Impact of deleting 5 DSM-IV personality disorders on prevalence, comorbidity, and the association between personality disorder pathology and psychosocial morbidity. *The Journal of clinical psychiatry*, *73*(2), 202–207. doi:10.4088/JCP.11m07140

Table 1. Means and standard deviations of the PNI and RME variables across gender.

Gender	Male (*n* = 47)		Female (*n* = 80)		Total (*n* = 127)	
	M	SD	M	SD	M	SD
PNI						
CSE	3.03	1.08	3.09	1.00	3.07	1.03
EXP	3.81	.97	3.49	.90	3.61	.94
SSSE	4.04	.93	4.00	.77	4.01	.83
HS	3.57	.91	3.61	.94	3.60	.92
GF	4.36	1.04	3.99	.98	4.13	1.01
DEV	2.53	.95	2.44	.96	2.47	.95
ER	3.15	1.04	3.15	.94	3.15	.97
Grandiose	4.07	.72	3.83	.65	3.92	.69
Vulnerable	3.07	.84	3.07	.81	3.07	.81
Total	3.50	.68	3.40	.64	3.43	.65
Reading the Mind in the Eyes						
Negative Accuracy	.75	.15	.77	.11	.77	.16
Neutral Accuracy	.66	.14	.70	.11	.68	.12
Positive Accuracy	.68	.15	.74	.17	.72	.17
Overall Accuracy	.69	.11	.73	.10	.71	.10

Note. PNI = Pathological Narcissism Inventory; CSE = Contingent Self-Esteem; EXP = Exploitativeness; SSSE = Self-Sacrificing Self-Enhancement; HS = Hiding the Self; GF = Grandiose Fantasy; DEV = Devaluing; ER = Entitlement Rage.

Figure 1. Example from the RME task (the correct response is *thoughtful*).

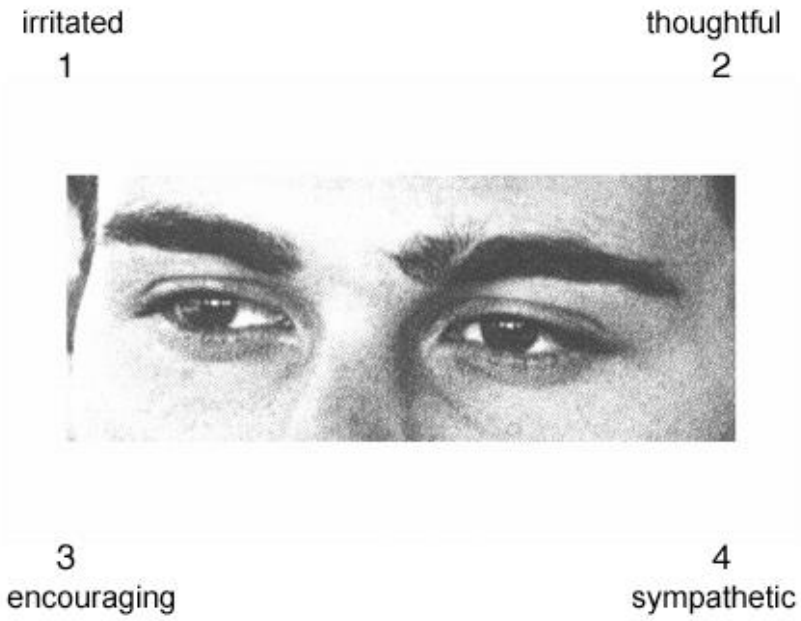
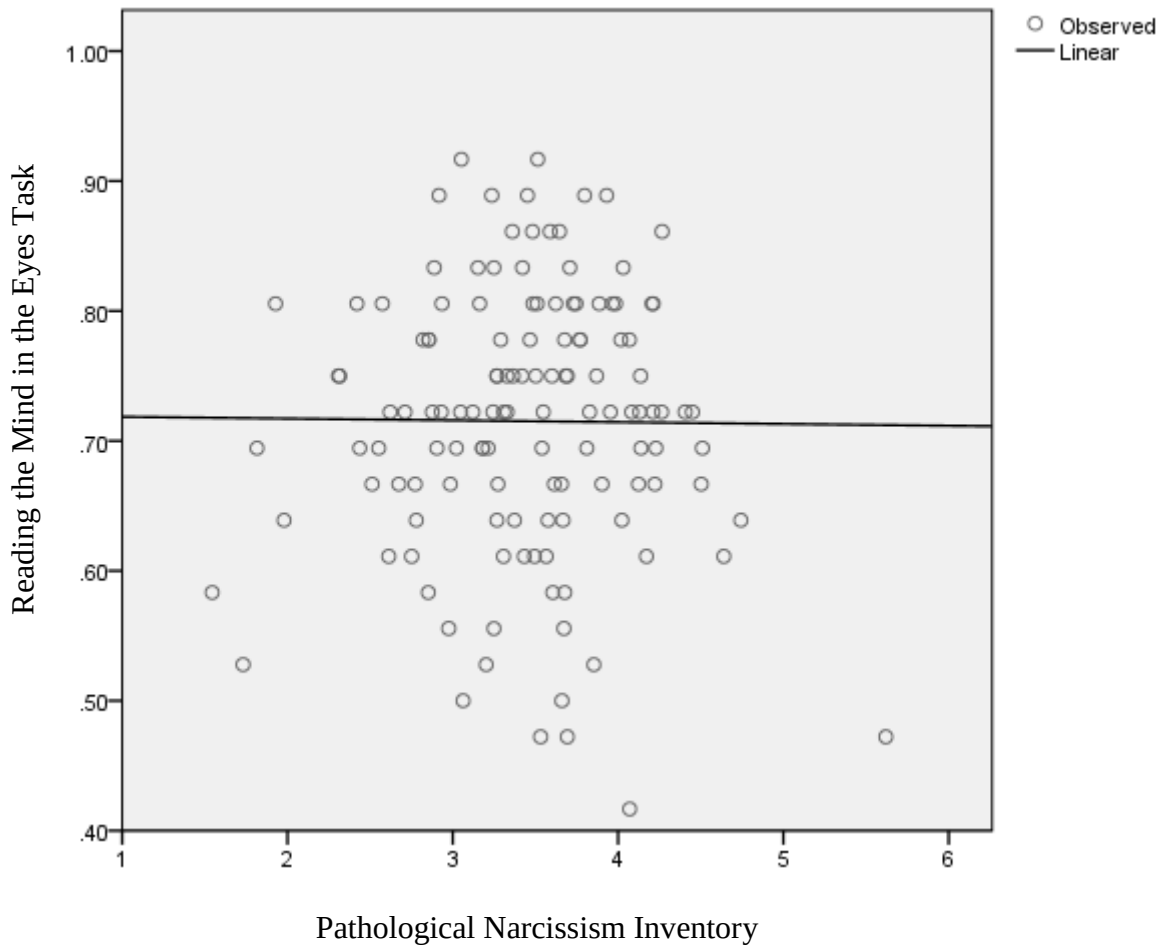


Figure 2. A linear analysis of overall RME accuracy across valences and the PNI.



Note.

Figure 3. A linear analysis of RME accuracy of negative-valence stimuli and the PNI.

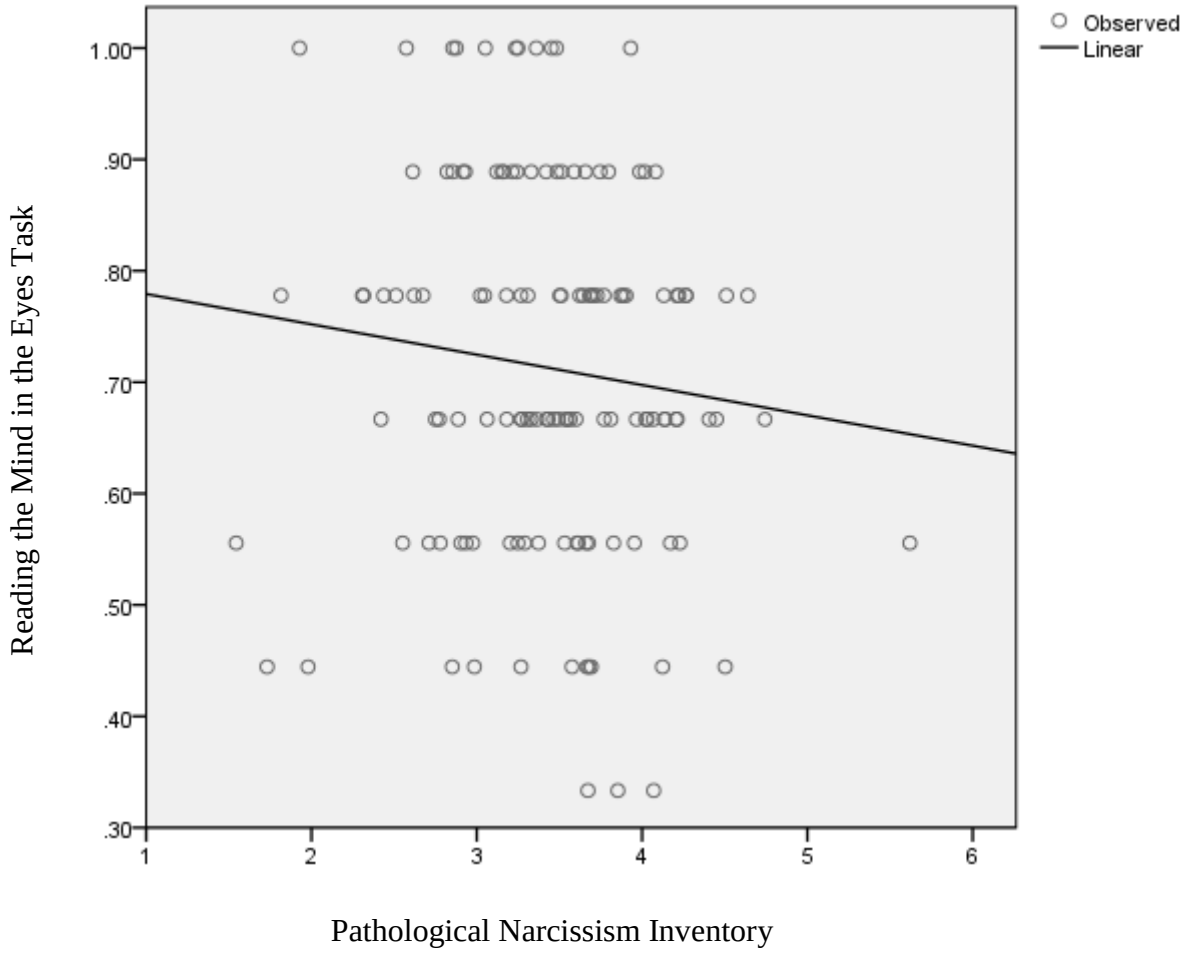


Figure 4. A linear analysis of RME accuracy of neutral-valence stimuli and the PNI.

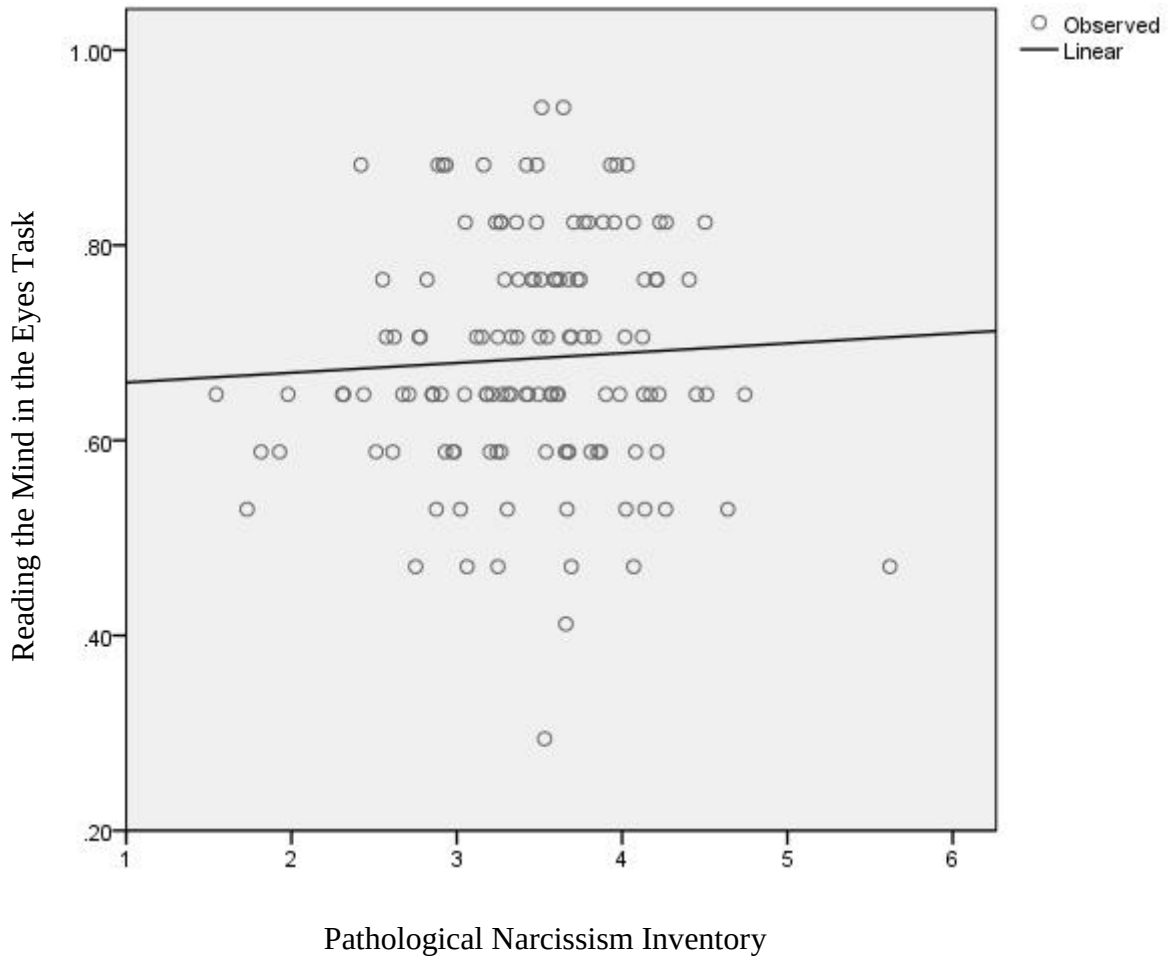


Figure 5. A linear analysis of RME accuracy of positive-valence stimuli and the PNI.

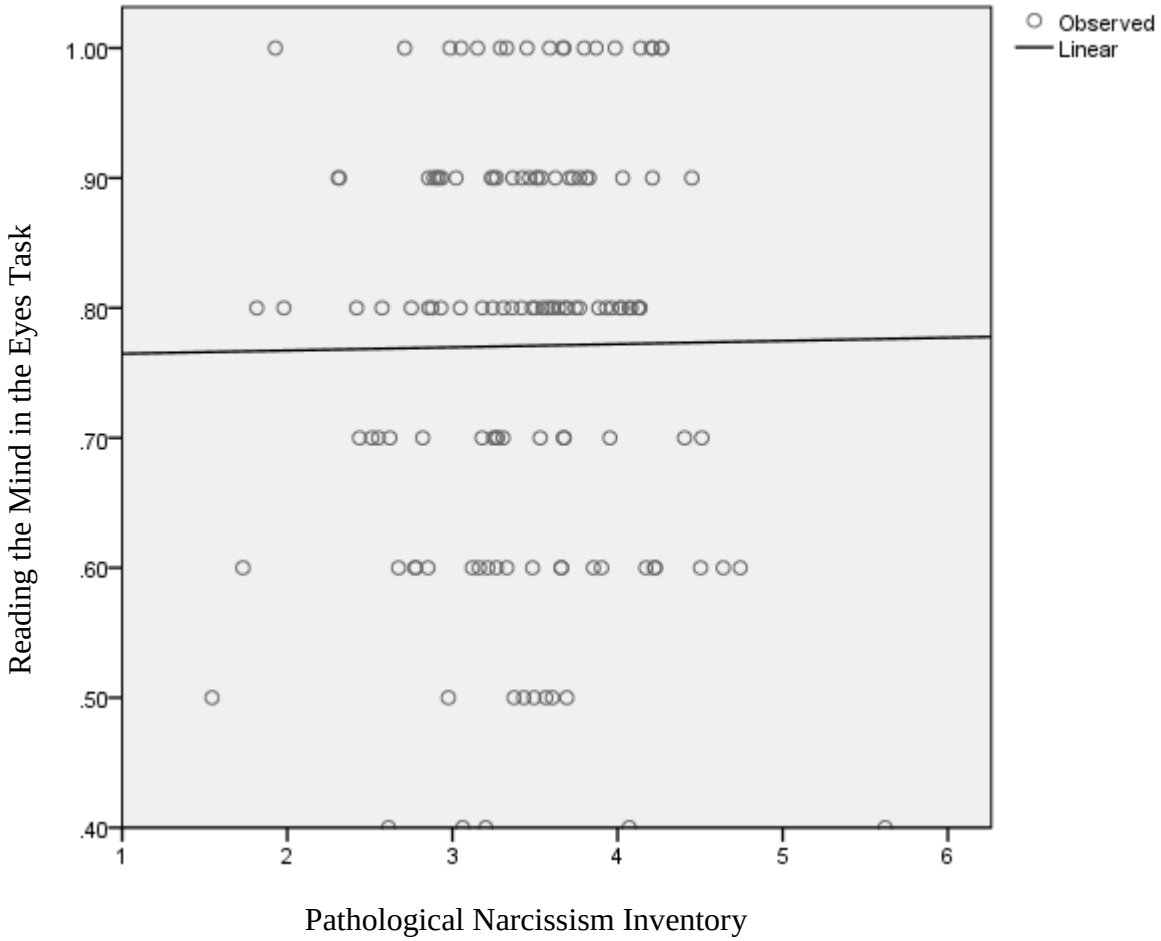
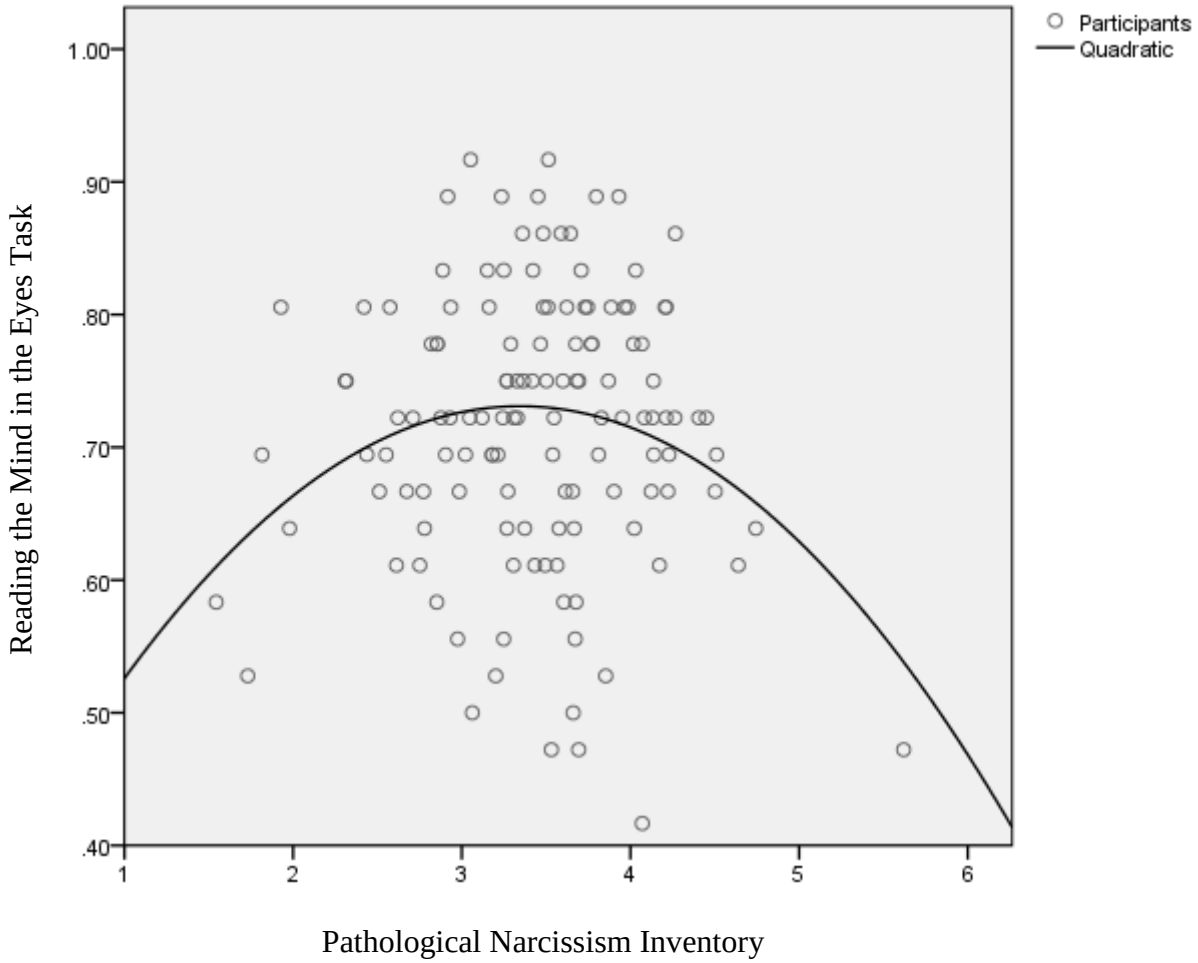


Figure 6. Results of a non-linear regression analysis of overall RME accuracy and the PNI. A significant quadratic relationship is displayed.



The Dopamine Transporter and Risk-Taking Behavior: The Role of Genetics in Addiction

Faith S. Pettyjohn, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Stephen J. Wilson, PhD
Assistant Professor of Psychology
Department of Psychology
College of Liberal Arts
The Pennsylvania State University

Travis T. Nichols
Graduate Student of Psychology
Department of Psychology
College of Liberal Arts
The Pennsylvania State University

Abstract

There is always the argument of environment versus biology in attempting to explain human behavior; this study examines the biological component of risk-taking. The Reward Deficiency Syndrome strongly points to a genetic component for risk-taking behaviors and this study sought to analyze the relationship between the dopamine transporter (DAT) and risking-related functioning as assessed with two tasks. In one task, functional magnetic resonance imaging was used to measure brain activity during a monetary feedback task. In the second task, risk-taking behavior was assessed directly using the Balloon Analog Risk Task. Gene sequencing provided allele type to compare to scores on these task, as well as to additional variables (e.g., demographic variables, self-reported substance use behavior). The overarching goal of the study was to examine the relationship between DAT genotype and addiction.

Introduction

When an individual exhibits a deficient reward system, response to natural rewards is affected. Things like food, sex, and similar activities will naturally stimulate the reward pathway in a properly functioning and wired brain. However, some individuals' brains are less responsive to such rewards; as a result they seek that feel good notion elsewhere. The ultimate goal for human existence is to survive and procreate. To accomplish these things, human behavior is driven by the reward process. Reward deficiency syndrome (RDS) represents this behavior at its extreme. RDS is defined as a deficiency of the reward pathway, and according to Blum, Cull, Braverman & Comings (1996), RDS is influential, among other factors, resulting in many personality disorders, and detrimental behaviors such as addictive, impulsive, and compulsive

actions. Dopamine is a major component of the reward pathway and therefore plays a fundamental role in RDS.

DAT is responsible for DA re-uptake from the extracellular space after it has been released. In a way, it is recycling DA. The amount of DA available in the extracellular space after accounting for the job DAT does depends in part on the allele carried. DAT 10 repeat (DAT 10R) and DAT 9 repeat (DAT 9R) correspond to levels in activity of the transporter. DAT 10R is more expressive, it is working more to have the DA recycled out of the extracellular space, and thus results in a decrease in DA there; DAT 9R is the least expressive allele, it is working less to recycle the DA, which results in more extracellular DA present (Bilder et al., 2004; Dreher et al., 2008; Hahn et al., 2011 & Yacubian et al., 2007). Since DA is the chemical with a major involvement in the reward pathway, it is expected that when less of it is in the extracellular space a dysfunction with reward processing can possibly occur.

That deficient processing is believed to manifest as RDS in which case people with it are especially prone to engage in risky behaviors like drug abuse, alcohol use, gambling, risky sexual activity and other things. As a result, their neural response to these activities is far more intense than a natural reward despite the fact that this effect is of shorter duration (Comings & Blum, 2000). The activities they choose to engage in resolves the issue of decreased or lack of response to natural rewards. The deficiency presented from lack of response to healthy rewards results in compensate with the negative behaviors. As the individual receives the chemical response sought the negative behaviors are reinforced. Many components in the brain interact to achieve functions like breathing, moving, comprehension, and a long list of other things. The brain is the fundamental feature of life. As a result many interactions in the brain are involved in the reward system and any number of components could result in the system becoming faulty. This project investigates the relationship between genetics, brain chemistry, and the Reward Deficiency Syndrome theory. In particular, this project seeks to determine how genetics affect the likelihood of risk-taking behavior as a link to addiction.

One variation of risk-taking that scholars widely acknowledge as significant is substance use. Researchers have sought to better understand addiction since every individual responds to substance use differently—some are able to moderate their use; others are more prone to abuse. Understanding which genes contribute to the predisposition of substance abuse may be highly beneficial to many communities. First, it may diversify treatment options. Also, researchers may be able to further examine the link between genetics and other risky behaviors.

Literature Review

Dopamine

Many researchers have studied and supported that dopamine (DA) is a major component involved in the chemical regulation of the reward system (Blum et al., 1996; Bilder et al., 2004; Comings & Blum 2000; Dreher et al., 2008; Hahn et al., 2011 & Yacubian et al., 2007**).** DA is known to people as the happy chemical and plays an important role in the reward process. Although many factors may affect the reward system it is possible that DA imbalance can result in its malfunction. During the experience of reward, cells in the ventral tegmental area (VTA) released DA into the following regions: nucleus accumbens, olfactory tubercle, ventral striatum (VS), the prefrontal cortex (PFC) (Comings & Blum, 2000), striatum, hippocampus, and prefrontal cortex (Dreher et al., 2008). Authors agree that the VS and PFC are especially

important in reward processing. DA levels in those regions of the brain influence many behaviors. Fluctuation in DA supports reward influence on unnaturally rewarding behaviors and hypotheses for why such behaviors occur (Blum et al., 1996; Bilder et al., 2004; Comings & Blum 2000; Dreher et al., 2008; Hahn et al., 2011 & Yacubian et al., 2007).

Since DA availability in the brain is linked to differences in reward processing it is important to understand what may contribute to differences in DA availability. Many studies have found genetic variation in genes involved in DA regulation impact DA levels in the brain. Many studies support the genetic variation from polymorphisms influencing the DA presence in the brain (Bilder et al., 2004; Dreher et al., 2008; Hahn et al., 2011 & Yacubian et al., 2007). RDS posits that several genetic variations involved in dopamine transmission can influence reward processing. Such genetic combinations seem to promote healthy reward processing while other combinations are associated with poorer functioning. Genetic variation influences functioning of the reward pathway. One gene of particular interest is the Dopamine Transporter gene (DAT). Blum et al. (2000) found variation in the allele present correlated to ADHD diagnosis in children. Blum et al. (2000) further found a correlation such that an individual exhibiting any single risky behavior put one at a higher risk of possessing other such behaviors. Although DAT in this study (Blum et al., 2000) was linked to just ADHD and not directly to other behaviors, there is other support for DATs' correlation to other risky behaviors(Moallem et al., 2012 & White et al., 2007).

Brain Activity

Tasks that activate the reward pathway activate a number of brain regions. Specific brain region activity that is consistent across studies depends on both genetics and examination of the reward delivery (Dreher et al., 2008; Hahn et al., 2011 & Yucubian et al., 2007). Throughout their studies activity varied depending on the phase of reward, whether the participants were receiving a reward or anticipating a reward at the time of neural activity examination. Depending on whether there was anticipation for reward or if the reward was actually received, the brain activity fluctuated based on which phase of reward was examined in the study.(Dreher et al., 2008; Hahn et al., 2011 & Yucubian et al., 2007). Brain activity differs between the conditions. Anticipation was correlated with ventral striatum activity while the prefrontal cortex activity was specific to receiving reward (Dreher et al., 2008). That finding was consistent with Yucubian et al., (2007) & Hahn et al., (2011) who both review anticipation of reward and found significant activity in the ventral striatum. The difference in activity is the result of reward manipulation, the reason that there are two significant regions that show separate levels of activity is essentially to the reward pathway involvement of many regions. As the reward type becomes specific it appears that activity too becomes less generalized to multiple regions and more prominent in certain regions. These studies are significant to the current study because examining brain activity in the right regions depends on the timing of reward.

Terms and Tasks

Reward processing has been operationally defined with a number of constructs: impulsivity, reward discounting, novelty seeking, and reward sensitivity. Ultimately they are all a measure of risk taking. From tasks like the guessing paradigm (Yacubian et al., 2007), Balloon Analog Risk Task (Moallem & Ray, 2012; White et al., 2007; Skeel et al., 2008; & Lejuez et al., 2003), and the Bechara Gambling Task (Businelle et al., 2008) there is support for risk taking

correlating with the reward processing system. These tasks correlate with self-reported risk ratings as well as personality tests that measure personality for expected behaviors. The Balloon Analog Risk Task (BART) is well known for having both validity and reliability. It correlates with real life risk taking as the task accurately predicts smokers based on performance when compared to nonsmoking participants (Lejuez et al., 2003). As a result, performance on the BART is a good measure to the likelihood of being an individual who is likely to take part in any number of the risky behaviors discussed.

Substance use as a risky behavior

Risky behavior can be defined in a number of ways, examined through a number of tasks, and include any categorization of the population. A risky behavior of interest is substance abuse, and studies examined cigarette smokers, alcohol drinkers, and individuals who identify as polysubstance users. Indeed, the list of risky behaviors is more extensive and can include sexual behaviors, gambling, stealing and even more behaviors. With substance abuse it is relatively easy to set up in a lab setting and measure the behavior with brain imagining and the tasks mentioned that are good risk taking measures. For example, Moallem et al. (2012) measured impulsivity differences between substance users by comparing task performance between participants who fit into the categories of smokers, heavy drinkers or fitting into a category including both. Their use of substance was the link to impulsivity. That study supported impairments of reward discounting correlating with substance use. This study was not capable of predicting which substances were used or the frequency of different substances used, instead it was an excellent predictor of whether a participant was a cigarette smoker on a non-smoker. Overall it was significant for impulsivity levels being a predictor of potential substance use. White et al. (2007) examined three traits that are directly linked to risk taking: reward sensitivity, impulsivity, and negative affect. They found support for the effect that personality traits had on risk taking as a function of substance dosage. In general there was a positive correlation between stimulant use and impulsivity found in the male participants. Ultimately what these articles hypothesized and found important was the idea that some people exhibit a predisposition for substance use when looking at factors of personality type like a certain degree of impulsivity or risk taking likelihood.

The articles just examined did not look at genes directly but looked at personality through questionnaires. The hypothesis for this paper is that genes influence reward processing which influences behavior. Many of the studies suggest a possible genetic predisposition examination of a few genes to find a possible link to addiction directly (Yacubian et al., 2007), or more generally to reward-seeking behaviors or psychiatric disorder (Dreher et al., 2008; &Hahn et al 20011). It appears certain that specific genes produce specific traits resulting in poorly sought behaviors.

The proposed objective of people indulging in such behaviors is to compensate for their deficient reward system that does not respond appropriately to the natural rewards. People who fit this criterion for RDS will take part in multiple risky behaviors (Comings et al., 2000; Blum et al., 1996). It is therefore important to understand one step at a time; one unnatural rewarding behavior at a time to see what is occurring that results in behaviors in only certain individuals, to understand the predisposition that put them at this disadvantage with risk taking. While some studies examined traits by subjects' performance on tasks that measure impulsivity and risk taking behavior, and others explored the brain activity of participants with specific alleles

present, this study examined both concepts together. In doing so the reference point is the RDS theory, and what results in the variation of behaviors, that is thought to be contributed by genes (Blum et al., 1996; Comings et al., 2000).

One way the variation has been examined and seems of great significance is through substance use. This behavior is important because people are well aware of the harms that substance use can have on the body. Although those risk factors exist many continue using and some people start even with examples of what use does to other people. There is also the factor that some people have more difficulty quitting than others. It is clear that not every individual responds to substance use the same. One difference that has been mentioned is that of genetics. Understanding the pieces of the genetic contribution to the predisposition of substance abuse can do many things for people who suffer. Seemingly of great importance yet to be mentioned is the ability to pin point possible mechanisms of other risky behaviors.

The current study investigated risk taking in individuals who report substance use (specifically, regular cigarette use). The study examines brain activation and multiple task performance similarities between participants. The following hypotheses were made: Hypothesis 1: Participants that present with DAT 10R allele are more likely to show less increase in the caudate nucleus, medial orbital frontal cortex, and ventral striatum region activity while completing the card task than those with DAT 9R. Hypothesis 2: Participants present with DAT10R allele are more likely to make riskier moves on the BART than those with DAT 9R, Hypothesis 3: Overall, poly substance users are expected to show least increase in the caudate nucleus, medial orbital frontal cortex, and ventral striatum brain region activity while completing the card task and also make more riskier moves on the BART.

Method

I. Participants

Fifty-one cigarette smokers participated in the experiment. Participants were solicited through advertisements, which detailed their eligibility. They had to have smoked at least ten cigarettes a day for the past twelve months. Subjects went through an initial screening session to ensure they qualified for the study over the telephone prior to coming in for a one of two in lab screening sessions to ensure qualification. The initial phone screening consisted of standard questionnaires. Prospective subjects were excluded if they self-reported having a mood or anxiety disorder or frequent illicit drug use, suggesting dependence use that was abuse was accepted for the purpose of this study. A standard SLEIC Magnetic Resonance Imagining (MRI) screening safety form was conducted to determine participants' MRI eligibility during the phone screening to ensure the MRI would be a safe. After this initial telephone screening, subjects who retained their eligibility completed two individual in lab sessions.

II. Materials:

The MRI Card Guessing Task

Participants were placed in the MRI to complete a card task utilizing the SLEIC standard operating protocol. Several trials of a card-guessing task adapted from previous research (see Delgado et al., 2000) were completed while in the MRI as brain activity data was collected. For each trial, participants guessed whether the numerical value of a visually displayed “playing

card" was higher or lower than 5. Participants were informed before beginning the task that each card would have a value ranging from 1 to 9, excluding the number 5. Each guess was either correct or incorrect for each trial. After a choice-making period lasting 2,500 ms, a number from 1 to 9 (excluding 5) was presented for 500 ms, followed by feedback (also presented for 500 ms). Such presentation of information informed subjects whether or not their guess was correct. For trials in which a correct guess was made, feedback consisting of a green arrow pointing upward was presented. In contrast, trials in which an incorrect guess was made, feedback consisting of a red arrow pointing downward was presented. Trials concluded with the presentation of a fixation cross for 11.5 s.

Participants were informed that each correct guess led to the addition of $1.00 to the total payment they would receive, while each incorrect guess led to the loss of $0.50 from this total. Participants were unaware that the card values were selected only after the response was made for each trial to ensure an equal number of positive feedback and negative feedback trials. Participants completed a total of 90 interleaved trials (45 of each feedback condition) divided into five runs of 18 trials each (Wilson et al., 2008).

Balloon Analogue Risk Task

With the BART evaluation of real world risk behavior engagement was examined through this task. The computerized task measured the risk-taking tendency. Participants were presented with a small balloon present on the screen and instructed to pump the balloon by clicking a button on the screen. For every click the balloon inflated a small amount and the participant earned money for each successful pump, in which the balloon did not explode. That earned money during the trail was placed into a temporary bank visible on the screen. At any point during the trail the participant could cash out by selecting the button on the screen that was labeled collect. At which time the money in the temporary winnings would be moved to the bank, no longer presented with the risk of losing that money. That trail ended at that point. The next trail began and the participant completed the task in the same manner. Each balloon was expected to pop at some random point between 1 and 128 pumps, with 64 pumps being the average breakpoint. A failure to cash out, that is press collect before the balloon popped resulted in all the temporary earnings being lost for that trail and another trail started after. Risk was measured in this task by the average number of pumps with higher scores being indicative of greater risk-taking likelihood. (Hunt et al., 2005 & Lejuez et al.,2003)

III. Procedure

Session 1

Full completion of Session 1 was about 2.5 hours. Subjects arrived to the lab and informed consent was reviewed and signed. After which, Carbon Monoxide (CO) readings were taken from every participant as a first step. The reading was obtained by requiring participants to first hold their breath for 15 seconds and exhale into the CO monitor. A reading of greater than 10 parts per million qualified participants for continued eligibility. If qualified to continue, subjects completed the Center for Epidemiologic Studies Depression Scale, which screened for current depression state. To remain in the study, participants were required to score below 16 points. Another questionnaire (Mini International Neuropsychiatric Interview) was completed

measuring drug dependence for substances other than nicotine, requiring a score indicating no dependence. At this point, non-eligible individuals were dismissed and compensated for the lab session. Remaining participants completed an Automated Operation-Word memory task to measure working memory and predict cognitive performance (Unsworth, Heitz, Schrock & Engle, 2005). Likewise, Digital Span tasks were completed to take another measurement of working memory.

Participants then provided demographic information and completed several surveys to assess behavior. They completed the Smoking History survey, Fagerstrom Test for Nicotine Dependence (Heatherton, et al., 1991), Nicotine Dependence Syndrome Scale (Shiffman, Waters, & Hickcox, 2004), Relapse Situation Efficacy Questionnaire, Revised Self-Consciousness Scale (Gwaltney, et al., 2001), Self-Control Scale (Tangney, Baumeister, & Boone, 2004) , Self-Consciousness(revised Self-Consciousness Scale; Scheier & Carver, 1985), Positive and Negative Affect Schedule (Watson, Clark, & Tellegen,1988), Barratt's Impulsivity Scale, Sensitivity to Punishment/Reward Questionnaire, and the Balances Inventory of Desirable Responding (Version 6; Paulhus, 1991). Upon completion of these surveys, participants were scheduled for their second session and instructed to avoid smoking or using any other nicotine products for 12 hours before arriving as well as directed to refrain from alcohol and recreational drug use for 24 hours before Session 2.

Session 2

At the start of the second session a second CO reading was completed to ensure that participants had not smoked during the time frame instructed. This second CO reading needed to be less than or equal to half the first reading in order for participants to proceed with the rest of the session. If participants informed the experimenter they had smoked or their CO levels were not in the correct range participants were given one opportunity to reschedule this session. Likewise, the reporting of alcohol and recreational drug use required rescheduling of the second session. After determining compliance with abstinence instructions , the remaining participants provided buccal cell samples. Such samples were collected to provide a source to study a genetic correlation with addiction through examination of the reward process. No deception occurred with the sample collection and this part of the study was completely optional. Participants that gave samples signed an informed consent form. To obtain the sample, subjects used cotton swabs to collect material from the inner lining of their cheeks. The sample was then placed into a vial with a preservative solution, marked with a bar code, which only linked the sample to the participants' subject I.D., and stored. Once the sample was collected, 4 questionnaires were completed: Positive and Negative Affect Scale–State, State Ego Depletion Scale, Smoking Consequences Questionnaire, Questionnaire on Smoking Urges-Brief, measuring for positive/negative affect, self-control, and desire to smoke. After completing the forms, participants rated their current urge rating on a scale 0-100 prior to entering the MRI. All of the steps leading up to the MRI took approximately 30 minutes to complete. The MRI portion of the study consisted of obtaining brain imaging and administering the card task.

Mid-way through the completion of the card task half of the participants were instructed on whether they could (Expected-shift group) or could not (Expected-stable group) smoke upon completion of the MRI task. Random assignment was used to group participants. Participants were grouped this way to examine the expectation of smoking on neural response to monetary gain. During the MRI, prior to the card task, scanning of anatomical imagining and diffusion

tensor (DTI) imaging was retrieved. Participants in the Expected-shift group were instructed after the MRI task to complete the lapse task, a behavioral task modeling smoking lapse behavior (McKee, 2009). Those in the Expected-stable group performed the Balloon Analog Risk task (BART), a computer task measuring risk-taking behavior (Hunt et al, 2005). Participants were instructed to pump the balloon on the screen to earn money with the risk of the balloon popping and losing the money earned during that trail. After the completion of either the Smoking Restraint task or the BART participants were debriefed. Not all of these measures were a focus of the present study. The current study will focus on pumps during the Bart, brain activity during the card task and the genetic sequence from the samples provide.

Results

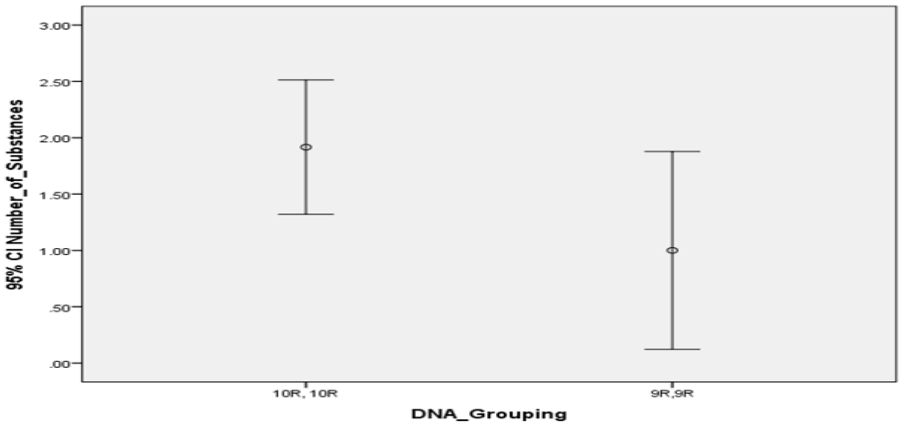
Genotyping

A large percent of the subjects in the experiment presented with at least one 10R allele, specifically 89.5%. That can be further broken down into 51.1% 10R, 10R; 36.2% 9R, 10R; 10.6% 9R, 9R; and 2.1 % with a unique allele type 8R, 10R. For analysis purpose, participants with allele types 10R, 10R were grouped together as Group 1 and participants with genotype 9R, 9R were grouped together as group 2. The 9R, 10R and 8R, 10R genotypes were eliminated from the analysis as done in previous studies since there was a very small number of such participants and as there is very limited data about these genotypes and reasoning behind expected behaviors.

Number of substances used and genotype

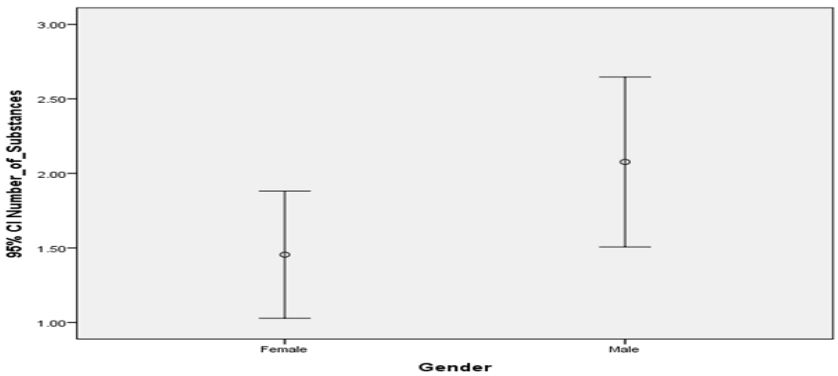
Subjects reported number of substances used as a part of a demographic survey. We used an independent samples t-test (2-sided) to see if genotype had an affect on the number of substances participants used. Participants were grouped by genotype (homozygous for 10R or 9R), and number of substances used excluded cigarettes. Using an alpha = 0.05 the t-test revealed no significance: $t(27) = 1.401$, $p = 0.173$ (10R: M + SD = 1.9167 +/- 1.41165, 9R: M + SD = 1.0000 +/- 0.70711).This indicated that genotype did not influence the number of substances used. Graph 1 illustrates the averages per genotype of substances used from no substances (zero) up to 5 other substances used within the last 12 month. Even though the difference was not statistically significant we can see that the 10R,10R group averaged a higher number of substances used, which is consistent with our hypothesis.

Graph 1



To examine the effects of other demographic variables on our dependent factors, a t test compared gender and number of substances used. With a t(46)= -1.750 p=.087, d= -0.516 (Female: M + SD = 1.4545+/- 0.96250 Male: M + SD = 2.0769 +/- 1.41204) there was no significance found, suggesting no difference between genders and use reported. Graph 2 illustrates the averages between the genders, which appear to be different. Examining the graph, males reported more substances. A chi-square test was conducted to examine allele frequency between genders as well. Table 1 illustrates the percentages of men and women with 10R alleles or 9R alleles. The analysis shows that $\chi^2(1, N=29)= 0.561$ $p = 0.453$, suggesting that there is no significance within the distribution of participants. Important to note is that 2 of the cells in the chi-square analysis showed counts of less than 5, because a chi-square test is not considered valid unless there is 80% of the cells with values of at least 5.

Graph 2



Graph 2 illustrates the difference in substances reported between genders

Table 1

Allele Type	Gender	
	Female	Male
10R, 10R	10	14
	34.50%	48.30%
9R, 9R	3	2
	10.30%	6.90%

Table 1 illustrates the percentages gather from a chi-square analysis of allele type occurring in a sample.

Participants were also grouped into categories of drinking pattern and a chi square analysis was conducted to compare drinking patterns between allele types. Participants were

grouped between 3 levels of drinking status: non-drinker, moderate drinker, and heavy drinker. For the purpose of this study, female participants reporting 3 or more drinks in one sitting or more than 7 drinkers in a week were heavy drinkers while the males were classified as heavy drinkers if they consumed more than 4 drinks in one sitting or more than 14 drinkers a week (Benton 2009). With a $\chi^2(2, N=29)= 1.621$, $p = 0.445$, $d = 0.544$ no significance was found between allele types and alcohol drinking frequency. Table 2 illustrates the percentages of allele types that fall into the categories of drinking pattern type.

Table 2

Allele Type	Drinking Pattern			Total
	Non-Drinker	Moderate Drinker	Heavy Drinker	
10R, 10R	1	12	11	24
	3.4%	41.4%	37.9%	82.8%
9R, 9R	1	2	2	5
	3.4%	6.9%	6.9%	17.2%
	2	14	13	29
Total	6.9%	48.3%	44.8%	100.0%

Table 2 shows the number and percentages of participants that were grouped by allele type and drinking behavior.

Behavioral Data: Risky decision-making

Genotype and BART

Participants completed two tasks during the study. Participants were randomly selected to complete the BART as one of the behavioral assessments. Two scores were averaged for each subject, one corresponding to the baseline target pump value and the other to the computer competition target pump value. . A t test analysis compared the baseline target pump between groups, depicting no significance $t(7) = -0.746$, $p= 0.480$, $d = -0.563$ (Type 10R: M+SD= 33.0300+/-13.57624; Type 9R: M+SD = 43.7700 +/- 0), suggesting participants did not differ significantly between pumps targeted. One factor that has an important effect on analysis is sample size. As noted in Table 3, only 1 participant that completed the BART was homozygous for the 9R allele. This greatly reduces statistical power and also limits the validity of any findings. Also was the case when comparing the second score from the BART task, revealing no significant difference in the scores by genotype when participants thought they were competing against the computer for target pump scores. For the group analysis between allele types for this

second score t(7) = 0.118, p = 0.910, d = 0.09 (Type 10R: M+SD= 53.8488 +/- 17.80100; Type 9R 2: 51.6300+/-0). Table 3 illustrates the means between the groups in both conditions.

Table 3

DNA Grouping		N	Mean	Std. Deviation	Std. Error
BART Base Target	10R,10R	8	33.03	13.57624	4.79993
	9R,9R	1	43.77	0	0
BART Computer Competition	10R,10R	8	53.8488	17.801	6.2936
	9R,9R	1	51.63	0	0

fMRI Data

Participants also completed a card task as a measure of affect of reward on brain activity. Specifically for the task, subjects made a response for each trial of the card-guessing task. Responses and reaction times were collected for all trials. Analysis of the caudate nucleus, medial orbital frontal cortex, and the ventral striatum activity was completed for the purpose of the study using peak coordinates, selected based on peak MNI coordinates for activity analysis for the brain regions of interest. Table 4 illustrates the peak coordinates used to examine the brain activity in each region of the brain.

Table 4

Caudate coordinates		MNI		
		x	y	z
Region	Left caudate	-8	14	2
	Right caudate	8	20	2
	Left ventral striatum	-10	10	-4
	Right ventral striatum	12	8	-4
	Medial OFC	0	48	-12

Table 4 shows the MNI coordinates.

Table 5 illustrates the differences in mean scores of brain activity between groups in which the averages for 10R, 10R was less than 9R, 9R as predicted. Table 5 specifically shows a smaller average for Type 10Rin the right caudate while depicting a smaller average also in the left caudate for Type 10R. Looking at the left caudate region, a two-tailed t test for independent samples revealed no significance comparing the activity between, Type 10R and 9R t(23)= -0.250, p= 0.805, d = -0.104 (10R: M+SD= 0.30689840+/- 0.219204970; 9R: 0.33223600 +/- 0.090830558). This suggests the groups did not differ in average increase in brain activity.

Similarly, when comparing participants' activity in the right caudate, no significance was found according to genotype (t(23)= -0.306, p= 0.762, d = -0.127 [10R: M+SD= 0.12612185 +/- 0.150995331; 9R: M+ SD = 14742200 +/- 0.056140239]). When examining the ventral striatum; for the right region no significance was found t(23)= 1.304 p= 0.205 d= 0.544 (10R: M+SD= 0.37410945+/- 0.233488450 9R: M+SD= 0.22914580+/- 0.158715392) left t(23)= 0.016 p= 0.987 d= 0.0066 (10R: M+SD= 0.29586395+/-0.227504175 9R: M+SD= 0.29411260+/- 0.173356512). Similarly when examining the medial orbital frontal cortex, no significance was found t(23)= 1.071 p= 0.295 d= 0.447 (10R: M+SD= -0.05702130 +/- 0.201724510 9R: M+SD= -0.15937820+/- 0.129705602).

Table 5

Group		N	Mean	Std. Deviation
Left Caudate	10R, 10R	20	.30689840	.219204970
	9R,9R	5	.33223600	.090830558
Right Caudate	10R, 10R	20	.12612185	.150995331
	9R,9R	5	.14742200	.056140239
Left VS	10R, 10R	20	.29586395	.227504175
	9R,9R	5	.29411260	.173356512
Right VS	10R, 10R	20	.37410945	.233488450
	9R,9R	5	.22914580	.158715392
Medial OFC	10R, 10R	20	-.05702130	.201724510
	9R,9R	5	-.15937820	.129705602

Overall, poly substance users were expected to have less activity in the caudate nucleus, medial orbital frontal cortex, and ventral striatum, as well as pumping more frequently on the BART than participants not using other substances. This prediction was generally confirmed as significant differences were found in two regions: the left caudate, t(3)= 4.325 p= 0.023 d= 4.994 (0 number of other substances reported: M+SD= 0.60813500 +/- 0.161920382 5 other substances reported M+SD= 0.09750820 +/- 0.109433355and the right ventral striatum, t(3)= 3.638 p= 0.036 d= 4.20 (0 other substances reported M+SD= 0.66755000 +/ 0.225072088 and with 5 other substance M+SD= 0.13002233 +/- 0.118216649. When we analyzed our other brain regions there was no significance found. For the right caudate region t(3)= 1.864 p=0.159 d= 2.152 (0 other substances reported: M+SD= 0.22503650 +/- 0.213466345 and for participants reporting 5 other substances M+SD= 0.00360733 +/- 0.051153754). The left ventral striatum resulted in t(3)= 1.401 p=0.256 d= 1.618 (0 other substances reported: M+SD= 0.49713500 +/- 0.119423264 and for participants with 5 other substances reported M+SD= 0.16713333 +/- 0.304618838). Lastly, we examined the medial orbital frontal cortex and found no significance t(3)= -0.641 p=0.567 d= -0.074. When we examined the scores for the BART, significance was found when participants played the first trial t(1) = 23.054 p= 0.028 d= 46.108 (0 other substances reported M+SD= 43.7700 +/- 0 and when participants reported 5 other substances M+SD= 35.1850 +/- 0.30406). Although there was significance found here, it moves in the direction opposite that of the hypothesis and suggests that participants that reported no substances pump more frequently than those who were classified as polysubstance users in our study. However when participants thought that they were competing against a computer (trial 2), this significant difference disappears, t(1) -1.013 p= 0.496 d= -2.026 (0 other substances:

M+SD= 51.6300+/- 0 and when participants reported 5 other substances: 59.1900 +/- 6.09526). Table 6 illustrates the differences between averages between our genotypes and activity and between our polysubstance users and the pumping frequency on the BART.

Table 6

		t test for Equality of Means		
Number of Substances		t	Mean	Sig. (2-tailed)
BART Base Target	.00	1	43.7700	
	5.00	2	35.1850	.30406
BART Computer Competition Target	.00	1	51.6300	
	5.00	2	59.1900	6.09526
Left Caudate	.00	2	.60813500	.161920382
	5.00	3	.09750820	.109433355
Right Caudate	.00	2	.22503650	.213466345
	5.00	3	.00360733	.051153754
Left VS	.00	2	.49713500	.119423264
	5.00	3	.16713333	.304618838
Right VS	.00	2	.66755000	.225072088
	5.00	3	.13002233	.118216649
Medial OFC	.00	2	-.26624500	.020004051
	5.00	3	-.17199100	.196843077

Discussion

The study examined multiple hypotheses linking risk taking to addiction as a function of DAT allele type.

Hypothesis 1:

Participants that present with DAT 10R allele are more likely to show less caudate nucleus, medial orbitofrontal cortex, and ventral striatum activity while completing the card task than those with DAT 9R.

The study examined the activity in the brain during the receipt of reward during a card task adopted from Delgado et al. (2000). We were specifically interested in the caudate nucleus, which is most responsive to the card task, and we also examined the ventral striatum and medial orbital frontal cortex as they are frequently implicated in reward processing. Table 4 illustrated the coordinates used to capture the most activity region of the brain areas of interest Literature encouraged the examination of the VS and medial OFC as they have either viewed the VS or the PFC. With p values revealing no significance, the mean values of brain activity in the regions examined during the card tasks required noting as they go in the direction of the hypothesis, predicting less activity in with 10R type participants. Specifically the right and left caudate regions have mean values of importance when comparing their directionality of the hypothesis.

That is a result of the caudate region being associated with the most robust activity during the card task. More specifically with the right side expecting more activity than the left side (Wilson et al., 2008) . Finding that it's mean values agree with the hypothesis is valuable and suggest that perhaps future studies could replicate this study using the card task and examining just this brain region. The fact that the average of the medial OFC exhibited decreased activity in participants with both types did not follow our expectations. The literature reported greater activity in the prefrontal cortex when receiving reward for our 9R type participants (Dreher et al., 2008), predicting less activity for participants with 10R. What was actually observed was a decrease in activity. Future literature can examine activity of the medial orbital frontal cortex more extensive as a function of reward.

Hypothesis 2: Participants present with DAT10R allele are more likely to perform poorly on the BART than those with DAT 9R.

As stated above, participants with the 10R allele type are representative of the more expressive gene, which results in more active transport of DA back into the synapse, leaving less DA in the extracellular space (Bilder et al., 2004; Dreher et al., 2008; Hahn et al., 2011 & Yacubian et al., 2007). Although no literature was found to directly measure risk taking with the BART as a function of genotype, prior literature showed the BART accurately distinguished between smokers and non-smokers. In our sample, the BART was unable to predict whether the participants used multiple substances. We were interested in the relationship between the genotype and risk-taking scores; in making this hypothesis that 10Rparticipants would make riskier moves on the BART there is the assumption that there would be some significant difference scores on substance use for these participants to fulfill the compensation idea discussed above. When referring to the analysis in graph 1this supporting the assumption as the means move in the direction of this hypothesis, although no significance was found there was moderate sized effect size. If in fact there was less brain activity than the 9Rtype as predicted in hypothesis 1, we expect the result of less responding to the natural reward of winning money would make participants more likely to partake in a risk-taking task such as the BART. This task is a great measure and accurate indicator of real life risk taking (Moallem & Ray, 2012). Analyzing the data we found no significance. However, when examining the average pumps during the task between genotypes when participants thought they were competing against the computer (refer to table 3), at which the 10R type pumped more frequently on average than the 9R type. Over all this finding seems to mimic more close the risky behavior, gambling, one of the risky behaviors listed early.

Hypothesis 3: Overall polysubstance users are expected to have less activity in the caudate nucleus, medial orbital frontal cortex, and the ventral striatum as well as perform more poorly on the BART by pumping more frequently.

This hypothesis first assumed that our polysubstance participants would be more likely to perform like our 10R genotyped group. This assumption was made based on the idea of there being support for the other 2 hypothesis, if participants with 10R had less brain activity than 9R (hypothesis 1) and they pumped more frequently during the BART (hypothesis 2), then we believed that those participants were less responsive to the natural reward, more responsive to the unnatural reward and thus more inclined to compensating by using more substances. That resulted in the prediction that polysubstance users would behave like the 10R, 10R participants. Although, it has been found that the BART was not a great indicator of polysubstance use

(Lejuez et al., 2003), we found significance for the performance on the task when participants completed the task normally, however the scores were in the opposite direction of the hypothesis. When examining the scores for when participants thought they were competing against the computer, the polysubstance users did in fact pump more frequently on average. That illustrates the similar fining with the 10R participants averages on the BART when they thought they were competing against the computer.

There was also significance found with two regions of the brain (left caudate nucleus and right ventral striatum) in which the brain activity was less in our participants that reported the most number of substances tried in the last 12 months. We also examined 3 additional brain regions, although no p values of significance were found; the left ventral striatum and right caudate nucleus showed brain activity averages that moved in the direction of our hypothesis. In examining the medial orbital frontal cortex scores, illustrated in table 6, noted is an average decrease in brain activity measured during the card task. When examining table 5 it illustrates the mean values of brain activity of participants grouped based on their genotype illustrated there is also an average decrease of brain activity. Much of the literature examined was focused on the caudate nucleus, ventral striatum and the PFC, although there is no direct link to the medial orbitofrontal cortex it was expected to show a similar pattern of activity as the PFC since it lies in that region. While we were interested in examining an increase in activity, less increase was predicted for both the 10R and poly substance users. With the 10R participants there was a smaller negative score meaning the brain activity decreased a lower amount than the 9R (Table 5). Similarly that pattern was found with the participants with more substances reported (refer to table 6). We suspect future work could examine the medial orbitofrontal cortex region.

This study attempted to examine multiple measures and can potentially influence future studies. Perhaps an examination of the relationship between DAT genotype, substance use, and frequency of substances used can be completed. Another study could examine the same tasks with DAT heterogeneous (9R, 10R) subjects who were eliminated from analysis. Specific to the findings with the orbitofrontal cortex, examination of other reward pathway regions require some attention to understand what kind of activity is expected there. In examining the concept of genetics and addiction there are possible benefits linked to establish proper treatment settings for certain types of individual. Understanding if an individual is genetically predisposed to risky behaviors can ultimately establish personalized treatment programs as well propose medication to correct the underlying chemical component examined here and other literature.

Limitations

Over all there was significance noted in the BART scores for both 10R and polysubstance use reported as well as significance found for the polysubstance participants and their brain activation levels. Many of the mean values of the data moved in the direction of the hypothesis but we think our small N may have limited us statistically. There were a limited number of participants and the DAT allele distribution was not symmetrical. This may have impacted our ability to detect this effect. Although we started out with 51 participants, after randomizing the participants who actually volunteered to give DNA and were also not excluded from MRI analysis, the N became 25 for the genotype and brain activity analysis. Also, once participants were randomly assigned to complete the BART or the other task that was not specific to the hypotheses our N for analysis was decreased to a N of just 9. But more importantly as a limitation is the DNA sequencing. Once sequencing of the participants the results for some of the analysis resulted in just one participant with the 9R allele or just one participant with 0

substances reported. These small N values are believed to have limited the analysis of the data. Another limit was that our participants only accurately reported alcohol and while other substance were reported for polysubstance use status we did not have an accurate score of frequency reported. Participants reported how often they drank on a daily or weekly bases, but when comparing other substance use participants were only able to report that they have used other substance over the course of the year but not how often.

Conclusion

According to the National Institute on Drug Abuse, addiction is chronic disease where the individual disregards the health issues that are present as they compulsively seek and abuse drugs. 1 in 8 Americans suffer from either a drug or alcohol problem.7% of Americans are affected by drug abuse and another 2% are affected by a drug addiction. In all of the people associated with drug abuse, 100,000 deaths occur each year in the United States, while tobacco accounts for another 440,000 deaths (Medicine.Net). Despite knowing that all these health risk exist, people continue to experiment with substances, and as a result we witness the struggle for some to quit, while others can successfully try substances and stop. It is certainly significant to continue learning what is so different between individuals that results in such difference in response to drugs. Such an important health topic needs to continue to be studied from the genetic aspect.

References

1. Blum, K., Cull, J. G., Braverman, E. R., & Comings, D. E. (1996). Reward deficiency syndrome. *American Scientist*, *84*(2), 132-145.

2. Businell, M. S., Apperson, M. R., Kendzor, D. E., Terlecki, M. A., & Copeland, A. L. (2008). The relative impact of nicotine dependence, other substance dependence, and gender on bechara gambling task performance. *Experimental and Clinical Psychopharmacology*, *16*(6), 513-520.

3. Comings, D. E., & Blum, K. (2000). Reward deficiency syndrome: Genetic aspects of behavioral disorders. *Progress in Brain Research*, *126*, 325-341.

4. Dreher, J. C., Kohn, P., Kolachana, B., Weinberger, D. R., & Berman, K. F. (2008). Variation in dopamine genes influences responsivity of the human reward system. *Proceedings of the National Academy of Sciences of the United State of America*, *106*(2), 617-622.

5. Hahn, T., Heinzel, S., Dresler, T., Plichta, M. M., Renner, T. J., Markulin, F., Jakob, P. M., & (2011). Association between reward-related activation in the ventral striatum and trait reward sensitivity is moderated by dopamine transporter genotype. *Human Brain Mapping*, *32*, 1557-1565.

6. Lejuez, C. W., Aklin, W. M., Jones, H. A., Richards, J. B., Strong, D. R., Kahler, C. W., & Read, J. P. (2003). The balloon analogue risk task (BART) differentiates smokers and nonsmokers. *Experimental and Clinical Psychopharmacology*, *11*(1), 26-33.

7. Moallem, N. R., & Ray, L. A. (2012). Dimensions of impulsivity among heavy drinkers, smokers, and heavy drinking smokers: Singular and combined effects. *Addictive Behaviors*, *37*, 871-874.

8. White, T. L., Wit, H. D., & Lejuez, C. W. (2007). Personality and gender differences in effects of d-amphetamine on risk taking. *Experimental and Clinical Psychopharmacology*, *15*(6), 599-609.

9. Yacubian, J., Sommer, T., Schroeder, K., Glascher, J., Kalisch, R., Leuenberger, B., Braus, D. F., & , (2007). Gene-gene interaction association with neural reward sensitivity. *Proceedings of the National Academy of Sciences of the United State of America*, *104*(19), 8125-8130.

10. Delgado, M. R., Nystrom, L. E., Fissell, C., Noll, D. C., & Fiez, J. A. (2000). Tracking the hemodynamic responses to reward and punishment in the striatum. *Journal of Neurophysiology*, *84(6)*, 3072–3077.

11. Gwaltney, C. J., Shiffman, S., Norman G.J., Patty, J.A., Kassel, J.D., & Gnys, M. (2001).Does smoking abstinence self-efficacy vary across situations?: Identifying context-specificity within the Relapse Situation Efficacy Questionnaire. *Journal of Consulting and Clinical Psychology 69*, 516-527.

12. Hunt, M.K., Hopko, D.R., Bare, R., Lejuez, C.W., Robinson, E.V., 2005. Construct validity of the Balloon Analog Risk Task BART: associations with psychopathy and impulsivity. Assessment *12*, 416–428.

13. Scheier, M. F., & Carver, C. S. (1985). The Self-Consciousness Scale: A revised version for use with general populations. *Journal of Applied Social Psychology*, 15, 687-699.

14. Shiffman, S., Waters, A., & Hickcox, M. (2004). The nicotine dependence scale: A

multidimensional measure of nicotine dependence. *Journal of Society for Research on Nicotine and Tobacco, 6(2),* 327-48.
15. Tangney, J.P., Baumeister, R.F.,&Boone, A.L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality, 72,* 271–322.
16. Unsworth , N., Heitz, R. P., Schrock, J. C., & Engle, R. W. (2005). An automated version of the operation span task. *Behavior Research Methods, 37(3),* 498-505.
17. Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of Positive and Negative Affect: The PANAS Scales. *Journal of Personality and Social Psychology, 54,* 1063-1070.
18.Wilson, S. J., Delgado, M. R., Sayette, M. A., & Fiez, J. A. (2008). Effect of smoking opportunity on responses to monetary gains and loss in the caudate nucleus. *Journal of Abnormal Psychology* , 117(2), 428-434.
19. Dryden-Edwards, R., *Drug Abuse and Addiction* MedicineNet (2012). Retrieved from http://www.medicinenet.com/drug_abuse/article.htm
20. The Science of Drug Abuse and Addiction. (December 2011). Retrieved July 18, 2012, from http://www.drugabuse.gov/publications/media-guide/science-drug-abuse-addiction
21. Benton, S. A., (2009). The High Functioning Alcoholic: Understanding This Hidden Class of Alcoholics From A Professional and Personal View. Psychology Today Retrieved from http://www.psychologytoday.com/blog/the-high-functioning-alcoholic/200904/social-drinkers-problem-drinkers-and-high-functioning-alc

Buying Early Education: The Role of Parental Motivation in Preschool Consumption

Jina Prince, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Maryellen Schaub, Ph.D
Assistant Professor of Education
Department of Education Policy Studies and Curriculum & Instruction
College of Education
The Pennsylvania State University

Abstract:

Early childhood education lacks sufficient scholarly attention. This mixed methods research study explored what motivates parents' decision-making process when they choose their children's preschool program. An investigation, including a questionnaire, interview, and a statistical analysis, was performed in a university town with parents from four preschool programs. Statistical data and qualitative data demonstrated that parent's education level, employment, and income relate to parents' preferences in various ways, especially if income levels were higher than $40,000 per year. Our study closes by urging future researchers in pedagogy and education policy to continue assessing what accounts for early education consumption.

Introduction:

Over time an increasing amount of emphasis from society is being placed on the education system; more pressure is being placed on schools to develop well rounded and intelligent students. Early education programs are where most students begin their educational experiences, and it is through early education that gives students a greater chance at success during their educational journey; "Early exposure to child care can foster children's learning and enhance their lives[...]" (Adams & Phillips, 2001, p.35). Since the government does not sponsor an early childhood education program for all children, parents hold the responsibility to find the best type of program for their child. By analyzing parent's motivation behind the selection process of a preschool program, the United States can begin to gain a better sense of how to best teach and support their students. The strengths from the programs that parents favor can be used and implemented in public school classrooms and aid in the process of strengthening the country's educational system. "Although researchers have described the child care arrangements that result from parents' child care decisions, surprisingly little is known about how these decisions are made, the factors that undermine or support them, and the consequences they have for the family. This gap in knowledge must be addressed" (Adams & Phillips, 2001, p.49). Not much is known about the motivation behind a parent's selection of child care and early education, and this gap in knowledge is what this current research aims to address.

This research aims to explore the reasons why parents send their children to a particular child care facility, and answer the questions:

1. Which elements of a particular preschool do parents think are important for early childhood development and learning?
2. Do particular preschools attract a certain demographic profile of students and families?
3. What effect does household income have on choice of preschool? What effect does mother's occupation or level of education have on choice of preschool?

Being able to answer these questions will allow for more of this country's attention to be placed on the importance of early childhood education programs and how to better construct these programs to ensure that students reach their fullest potential.

Literature Review:

Throughout this research paper there will be certain terms mentioned, and for this studies purpose the terms will hold the listed definitions.

1. Montessori- A holistic educational approach in which the teacher acts as a guide and the multiage-age classroom is filled with self-teaching objects to develop high levels of self-esteem, self-confidence, and competence (Corry, 2006)
2. Head Start- A federally funded program targeting children ages 3-5 and providing a variety of services, including education in the form of preschool, and nutrition and medical services ("Head start services,")
3. Play School- An informal nursery group taking preschool children in half-day sessions that use play as the major way of allowing children to learn (Corry, 2006)
4. Traditional- A traditional approach where the teacher delivers district-prescribed curriculum using a variety of instructional methods to reach all students in his/her classroom (Corry, 2006)
5. Early Childhood- "Defined as preschool through third grade in this study" (Zarybnisky, 2010, p.6)

In the past, society has believed that intelligence was inherited and innate in a human being rather than being developed through experiences over time. These ideals were held by the majority of citizens until the 1950s when researchers began to challenge old views of intelligence. "The mainstream view had long been that intelligence was fixed, determined largely through heredity, but in the 1950s and early 1960s researchers started to argue that it could be modified through experience. The work of J. McVicker Hunt and Benjamin Bloom promoted the idea that intelligence was plastic and that the child's environment was a critical factor in development" (Rose , 2010, p.15). The federal government took this newly discovered information and tried to use it to build support for the Johnson administration's antipoverty efforts.

Kindergarten and preschool programs were not available to all children in the 1960s but that would soon change with the development of the Head Start program. During the Johnson administration early education began to take shape in the United States. In an effort to reduce the negative effects of poverty on children, the government thought that creating a special program, called Head Start, would be beneficial for the country's disadvantaged children. Head Start is a preschool program that encompasses not only classroom learning but medical and dental care, nutritious meals, home visits, parent participation, and community organizing; it allows for the impoverished families of the nation to give their child a head start in education (Rose, 2010). This idea of a Head Start program brought light to the idea of early education through preschool,

it “drew national attention to the promise of preschool for poor children, and in so doing raised questions about whether early education might benefit all children” (Rose , 2010, p.35). Head Start sparked an interest of early education in middle and upper class parents; seeing the positive effects a preschool program had on children of poverty, such as socialization, academic education, and better health practices. This lead them to see the many positive benefits a preschool program could also have for their own children.

Enrollments in early education programs began skyrocketing not long after Head Start’s creation. Parents were catching on to the idea that there were positive benefits and more to early education than supervision over students; “Citing research about the early development of children’s intellectual capacity, they assert that all children, not just the ‘disadvantaged,’ could be helped by early education” (Rose , 2010, p.38). Parents were not the only ones calling for early education, educators were also urging for preschool education to be offered for all children. Shortly after, more preschool programs, that were not Head Start programs, began opening. This allowed for more children to enroll even if they were not living in poverty. Families realized the importance of an early education and enrollments in preschool programs rose significantly in a short amount of time. It was noted in a 1966 *Newsweek* article that, “preschool enrollment was at an all-time high; while wealthy families were eager to get their children into the preschools linked to exclusive private schools, middle-class parents were inspired by Head Start to enroll their children in nursery schools...‘Many educators feel it is only a matter of time-and a considerable amount of money-before every 3-, 4-, and 5-year-old can toddle off to preschool’” (Rose , 2010, p.37). The enactment of the Head Start, federally funded, program began the start of the early education system in the United States; then the rapid rise in enrollments in preschool programs continued this shift in ideals. The next part would be up to the parents to choose a program that is best suited for their child.

Parents may not perceive themselves as consumers of education. Similar to child care, however, many early childhood education programs are an enterprise. One major reason parents have difficulty choosing a pre-kindergarten institution is because they are not prepared (Bainbridge & Sundre, 1990). Unlike child care, in which parents typically must make conscious decisions as to which providers are most compatible to supervise their children, choosing a preschool program requires much more consideration as to what type of learning environment, curriculum used, or teacher-student-parent relationship is best for the child. Among mothers of preschool-aged children research has shown that children over the age of three are typically placed in formal preschool or nursery programs (Kuhlthau & Mason, 1989). It may have been common practice for care at home to be the popular choice for mothers at one point in time, but it is now not the ideal choice for mothers. More mothers are working to provide for their families, therefore, it is no longer ideal or possible to provide at home care. Attitudes towards education have also shifted, parents are more concerned about the education their child receives and wants to place them at an advantage for the child’s future. The rapid speed of change in society has left a gap between parents’ beliefs and abilities and what is necessary in choosing an adequate preschool program. Many parents are satisfied with substandard programs because they are not well enough informed on how to strategically choose a program for their child (Little & Zinzeleta, 1997). Parents lack knowledge as consumers and often times do not know what they should be truly looking for in a program; they often lean on recommends from family, friends, and ads in newspapers and magazines (Fuqua & Labensohn, 1986).

Although parents may not always recognize the diversity of early childhood programs available to them, both intrinsic and extrinsic characteristics affect their choice of institution. The

characteristics of a program play a significant role in why parents place their child there. Two groups of characteristics have been found to play a major part in this decision; parents place importance and rates on different characteristics that programs offer. "These importance ratings cluster into two groups: importance of extrinsic, or adult-oriented, characteristics of care (i.e., distance from home, distance from work, available hours, and cost) and importance of intrinsic or developmental factors (i.e., type of program offered, educational materials used, training of staff, and availability of recreational equipment)" (Johansen, Leibowitz & Waite, 1996, p.763). Working parents are more influenced by the extrinsic factors because of their employment demands more than other parents. Those parents that place a higher value on their child's overall development are more inclined to choose a more formal preschool program; while those that value their child knowing and having a relationship with the caregiver more often choose family home care (Johansen, et al., 1996).

Programs such as Montessori, Play School, Head Start, and traditional offer aspects of early childhood education for the needs of different families. Parents go to programs based on how well that program works to meet the needs of their children and their specific family. Montessori parents were found to place "the most importance on academics, discipline, socialization, interaction with the classroom teacher, and individualized attentions from the teacher" (Zarybnisky, 2010, p.87). Montessori schools have placed an emphasis on these aspects of early childhood education, which is why it is such a good fit for these particular parents. It is up to the parents to be wise consumers and choose the type of program that offers the characteristics that work best with their child and their family.

Research Methodology:

Participants

This research study was conducted using a mixed methods approach. The participants of this study are parents living in a university town, whose children are between the ages of three to six years old. Their children are currently enrolled in four different types of preschools. The first is a traditional center which is the classic preschool experience that highlights socialization and pre-academic skills; these types of centers vary greatly and are usually offered through religious organizations, community centers or in child care centers. The second is a Montessori school where there is an emphasis in independence, freedom within limits, and learning through discovery for the students. The third is a Head Start, which is a program run by the federal government to provide comprehensive education, health, nutrition, and parental involvement services to low income students and their families. The last is a Play School which focuses more on the sensory, motor, and social development of a child over the typical pressure placed on academic skills. Participants were recruited through a classic snowball sampling; parents were given an interest form as well as a note that they would be receiving compensation for their participation. Since all participation was voluntary, there was no random sampling in this study. All participants received payment of fifty dollars after they completed the follow up interview and handed in all completed paper work. A total of twenty-six parents completed all components of the research project.

Components of Research Design

Participants of this research project had to complete three different tasks to be eligible for the study.

Consent Form and Interview Request Sheet

Parents were asked to first complete a consent form and then an interview request sheet. The consent form gave a brief introduction of the researcher conducting the study, a professor at Penn State, and general overview of what is being studied, parenting cognitive development; also that participants could receive fifty dollars. The purpose of the study was to explore parental views on early childhood and appropriate activities for young children. The procedures of what parents had to do were given, then any discomforts or risks, which were no foreseeable risks or discomforts. The benefits were stated along with the duration and amount of time the study would take. A statement of confidentiality and there rights to ask questions were given. Finally information on compensation for their participation and that the study was completely voluntary were listed. The interview request form simply restated what was required of the participants during the study, the contact information of the researcher, and a place for the parents to fill in their names, address, best time and date for an interview, and their signature.

Questionnaire

The participants were next asked to complete a questionnaire that contained various questions about family background including: parent education, parent occupation, work status, income, child age, number of siblings, and school attendance. Furthermore, the questionnaire asked questions about home activities, like reading, outings, and parent/child engagement. Additionally, parents had to evaluate their child's cognitive abilities, virtues, literacy competence, and television viewing habits. Finally, subjects had to select sources of information that influence major decisions they make about their child's education.

Interview

The final part to this research study was a follow up interview with the parent that completed the questionnaire. The semi-structured interview lasted between forty-five minutes and an hour; this follow up interview allowed for parents to describe in further detail how they felt about early education, the preschool that their child attends, and their participation in their child's education. Parents did not have to answer any questions that they did not feel comfortable with answering, and were allowed to stop participation in the study at any time of their choosing.

Data Analysis Methodology: A Mixed Methods Approach

The data collected from the questionnaire will be analyzed with a program called Statistical Packages for the Social Sciences (SPSS) and used to aid in answering the questions of what elements of a preschool are important for early childhood development? Does a particular preschool attract a certain demographic profile of student and family? What effect does household income have on choice of program? What effect does mother's occupation or level of education have on choice of program? Basic descriptive statistics will be used with the data in order to analyze the findings; frequencies, cross tabulations, means, and standard deviations will be the main type of descriptive statistics being analyzed.

In terms of analyzing the data collected from the follow up interviews with the parents, this study will focus on two particular questions from the interview, "How did you choose this preschool?" and "What elements of this preschool are important for early childhood development?". I look at overall trends in parent responses. Next, I look at parent responses by school to investigate if parent choice of preschool is associated with parent ideas about early childhood development; looking for commonality in responses by a particular variable or by type of preschool program. Finally, I look at preschool choice by the income and education category

to look for associations between family background characteristics and preschool choice. Together with the quantitative findings and the qualitative analysis the researcher will be able to gain a better sense as to what motivates parents to send their children to preschool. All parts of this study were private and all information gained from the participants will be kept confidential.

Results:

Quantitative

Table 1:

Descriptive Statistics				
School	N	MomEd	MomWork	Family Income
Head Start	4	1.75 (.500)	5.5 (6.81)	6.25 (.500)
Play School	8	3.5 (.756)	6.75 (6.45)	9.13 (1.13)
Montessori	6	3.5 (.548)	22.67 (23.04)	8.83 (1.17)
Traditional	8	3.13 (.835)	6.75 (11.35)	9.37 (.744)
Total	26	3.12 (.909)	10.23 (14.42)	8.69 (1.41)

Footnote: *For the columns MomEd, MomWork, and Family Income the first value listed is the mean while the second value in parentheses is the standard deviation. The parents that are have enrolled their child in this Head Start program are not typical families that utilize Head Start's services. These families qualify for this program because they are temporarily considered low-income. They have one parent that is in graduate school and the other parents is unemployed. A typical Head Start family is low-income working towards being middle class; however, the families in this Head Start group will be middle class by the time the parent finishes their graduate studies.*

This table lists the basic statistics of the data from this research study. There were 26 parents that participated and completed all necessary parts in this project. These parents had children enrolled in four different preschools: four from Head Start, eight from Play School, six from Montessori, and eight from a traditional preschool. This study is focuses on determining if there is a relationship between a mother's education level, amount of hours worked, and family income on which type of preschool they chose for their child to attend.

Table 2: Cross tabulations of Family Income

Family Income						
School	$25K-$30K	$30K-$40K	$40K-$50K	$50-$75K	$75K+	Total
Head Start	75% (3)	25% (1)	0% (0)	0% (0)	0% (0)	100% (4)
Play School	0% (0)	12.5% (1)	12.5% (1)	25% (2)	50% (4)	100% (8)
Montessori	0% (0)	16.7% (1)	16.7% (1)	33.3% (2)	33% (2)	100% (6)
Traditional	0% (0)	0% (0)	12.5% (1)	37.5% (3)	50% (4)	100% (8)
Total	11.5% (3)	11.5% (3)	11.5% (3)	26.9% (7)	38% (10)	100% (26)

Footnote: *Family income per year by percentage, the second number in parenthesis is the actual numerical count.*

Table 2 compares the four different schools and how they compare to family income. All of the families fit into the income bracket of twenty-five thousand or more, therefore no family

had an income level lower than twenty-five thousand dollars a year. When looking at the row for Head Start it is immediately evident that there is a relationship between families that make less than forty thousand dollars and the Head Start preschool program. The majority of families with children in the Head Start program make less than thirty thousand dollars a year, none making more than forty thousand a year which makes all of these families low-income. This is not surprising because to qualify for Head Start services the family income must be determined to be at or lower than the federal poverty level. However, when looking at the other three preschools, Play School, Montessori and traditional, the family income level varies.

None of the families in the other three programs make less than thirty thousand dollars a year, but there is no one income level that a majority of parents of a certain preschool fall into; the family income levels are dispersed throughout. Concerning traditional, Montessori, and Play School preschools there does not appear to be any relationship between school choice and family income. However, for obvious reasons, there is a relationship between family income and Head Start with the parents in the lowest family income levels. Therefore, although we can say there is a statistical relationship between the lower income levels and preschool choice, we cannot determine a statistical relationship to be present between the higher income levels and choice of program. Since these families' income levels are higher, they have more options when it comes to choosing a preschool program; however, their level of income does not predict which of these programs they choose.

Table 3: Cross tabulations of Hours Mother Works

	Hours Mother Works						
School	**0 hrs**	**1-10 hrs**	**11-20 hrs**	**21-30 hrs**	**31-40 hrs**	**41+ hrs**	**Total**
Head Start	50% (2)	25% (1)	25% (1)	0% (0)	0% (0)	0% (0)	100% (4)
Play School	37.5% (3)	37.5% (3)	25% (2)	0% (0)	0% (0)	0% (0)	100% (8)
Montessori	33.3% (2)	16.7% (1)	0% (0)	0% (0)	33.3% (2)	17% (1)	100% (6)
Traditional	62.5% (5)	12.5% (1)	0% (0)	25% (2)	0% (0)	0% (0)	100% (8)
Total	46.2% (14)	23.1% (6)	11.5% (3)	8% (2)	7.7% (2)	3.8% (1)	100% (26)

Footnote: *Percentages are in hours worked per week, the second value which is in parenthesis is the actual numeric count*

Table 3 looks at the types of preschools with the amount of hours the mother works. It is evident that almost half of the mothers, regardless of which type of preschool they send their child to, do not work outside the home. Concerning the other half of mothers that do work, the majority of them work between one to twenty hours per week. From this table we can gather that about half of the mothers do not work for pay, and the typical working mother is only part time. Mothers working between zero to thirty hours a week vary in which type of program their child attends. However, it is interesting to note that those few mothers that do work thirty hours or more per week send their child to the Montessori preschool. Since, a little more than half of the mothers do not work outside of the home and there is such variation in program choice we are unable to draw any significant or strong relationships between this variable and choice of preschool program.

Table 4: Cross tabulations of Mother's Education Level

Mother's Education Level					
School	**High School & less**	**Some College**	**Bachelor's Degree**	**Bachelor's & Higher**	**Total**
Head Start	25% (1)	75% (3)	0% (0)	0% (0)	100% (4)
Play School	0% (0)	12.5% (1)	25% (2)	62.5% (5)	100% (8)
Montessori	0% (0)	0% (0)	50% (3)	50% (3)	100% (6)
Traditional	0% (0)	25% (2)	37.5% (3)	37.5% (3)	100% (8)
Total	3.8% (1)	23.1% (6)	30.8% (5)	42.3% (11)	100% (26)

Footnote: *The first value is in percentages, the second which is in parenthesis is the actual numeric count.*

Table 4 shows the percentage of children in a specific type of preschool by their mother's education level. Similar to table 2, where preschool choice is compared with family income, the results shows that mothers that send their children to Head Start have less education than other mothers. The mothers with a child in Head Start have an education level of high school and less or some college. Education level and family income are strongly related. The education levels of the mothers from the other three preschool programs vary greatly throughout the table. Since there is such a small sample size, we were not able to determine a pattern or statistical relationship of preschool choice and mother's education level. Although no patterns were found some interesting facts did emerge; all mothers with a child in the Montessori program have at least a bachelor's degree or higher. More than half of Play School mothers, 62.5%, hold a bachelor's degree and higher; while those that have children in the traditional preschool vary almost equally across the education levels of some college, bachelor's degree, and bachelor's degree and higher. Though the mothers of children in Montessori, traditional, and Play School preschools do not have an education level of high school or less, there is no one specific education level that they fit into according to the preschool that their child attends.

Overall, there seems to be very little statistical relationship with the variables and preschool program concerning the Montessori, Play School, and traditional preschool. Although there is no statistical relationship with these programs, there does seem to be a relationship or pattern that has emerged. It seems that if the family's income level is low and the mother has a lower level of education the parents are more likely to send their child to a Head Start program. However, we cannot see this same pattern with the other preschool programs and the variables. This quantitative data gives a broader picture of the variables and the role they play in how parents choose a preschool for their child. The tables show that parental choice is based on something other than family background characteristics.

Qualitative

The quantitative data showed that there were other factors involved, other than family characteristic, when it came to choosing a preschool. The parents who participated in this study completed an interview along with the questionnaire, where they could further explain their ideas and beliefs about early education, of their responses this study will look at their answers to the first two questions: "How did you choose this preschool?" and "What elements of this preschool are important for early childhood development?". These two particular questions will give a more detailed account of how parents came to their decision.

Table 5: Most Common Responses Given by Parents by Preschool

School	#1	#2
Head Start	Recommendations, older Sibling	Socialization, Independence
Play School	Parent Involvement, Idea of Play	Variety of Activities, Loose Structure
Montessori	Recommendations	Balance of Socialization & Academics, Exploration
Traditional	Recommendations, Home Church	Listen, Follow directions, Share, & Socialization

The responses given by parents to the first question, "How did you choose this preschool?" there was much commonality in what parents had to say according to which program their child was attending. Parents of children in Head Start's main reason for choosing this program were because it was recommended to them or one of their older children has previously attended the program. Play School parents' reasons dealt more with the elements of the program. Overwhelmingly, these parents valued the aspect of parent/family involvement in the preschool, they also liked the idea of learning through play and how the child got to choose what they did. Another commonality among the parents' responses was that both the indoor and outdoor environment was a "good space". Those parents with a child in the Montessori preschool mostly chose the program because they received high recommendations from their friends; many of them had friends with children that attended the program. Parents who chose the traditional preschool program did so because they attended the church that ran the program, as well as receiving high recommendations by friends.

The second question gave parents more of an opportunity to be specific when responding to, "What elements of this preschool are important for early childhood development?" Those that chose Head Start valued the idea of social interactions and their child learning independent task such as tying their shoes, using the bathroom, and buckle their own seat belt. While those parents sending their child to the Play School high regarded a variety of activities, learning through play and not having the program be too focused on academics, and a loose structure. Montessori parents identified the elements of the program having a nice balance of both socialization and academics, individualization, and the "ability to explore without too much structure." Parents with children in the traditional program had the most commonality in their responses, which were that they wanted their children to learn how to listen and follow directions, share, and socially interact with other children.

Limitations:

The main limitation in this research study was the sample size; this specific study had a total of twenty-six participants making it more difficult to find correlations and statistical relationships. The sample size needs to include more participants as well as participants in other geographic locations besides one university town. Variation will allow for a stronger relationship

to be identified. The second limitation was that this study utilized self-reported questionnaires, therefore, some of the data could not be fully representative of the sample.

Discussion:

The findings from this study allowed for the researcher to gain a better idea of the role parents play in the consumption of their child's early education. Through the quantitative data we were able to determine that there is no direct correlation between family income, mother's education level, and mother's occupation to the type of preschool their child attended, concerning the Montessori, Play School, and Traditional programs. However, we did find a pattern that showed low family income and low mother's education level were related to type of preschool program. Head Start showed to be closely related to low family income and low mother's education level. There is not one characteristic of a family's background that predicts or correlates with the type of preschool program chosen by the parents.

Overall, this study has found that parents value many different things in a preschool program; many elements have been identified to be important in an early education program by parents. Through this study we could not identify a specific element that motivated parents to enroll their child in a preschool program. However, we were able to identify that those parents with children in the same type of preschool all valued the same elements. Future researchers should expand this study to include more participants with a greater variation. A larger sample size might provide more clarity between these variables and their effect on parents' choice of care.

Works Cited

Adams, G., & Philips, D. (2001).Child care and our youngest children. Retrieved from http://www.jstor.org/stable/1602808

Bainbridge, W., & Sundre, S. (1990). Parents as consumers of public education. The Education Digest, 56(4), 41-42. Retrieved from http:// search.proquest.com.ezaccess.libraries.psu.edu/docview/218187413/abstract

Corry, S.K. (2006). A comparison of Montessori students to general education students as they move from middle school into a traditional high school program. Dissertation published by the University of Nebraska ‿Omaha.

Fuqua, R., & Labensohn, D. (1986). Parents as consumers of child care. Family Relations, 35(2), 295-303. Retrieved from http://www.jstor.org.ezaccess.libraries.psu.edu/stable/ 10.2307/583638?origin=api

Head start services. (n.d.). Retrieved from http://transition.acf.hhs.gov/programs/ohs

Johansen, A., Leibowitz, A., & Waite, L. (1996). The importance of child-care characteristics to choice of care. Journal of Marriage and Family, 58(3), 759-772. Retrieved from http://www.jstor.org.ezaccess.libraries.psu.edu/stable/10.2307/353734?origin=api&

Kim, J., & Fram, M. S. (2009). Profiles of choice: Parents' patterns of priority in child care decision-making. Early Childhood Research Quarterly, 24(1), 77-91. doi:10.1016/ j.ecresq.2008.10.001

Kuhlthau, K., & Mason, K. (1989). Determinants of child care ideals among mothers of preschool-aged children. Journal of Marriage and Family, Retrieved from http://www.jstor.org/stable/352159

Rose , E. (2010). The promise of preschool: From head start to universal pre-kindergarten. New York, NY: Oxford University Press.

Zarybnisky, E. (2010). A ray of light: A mixed-methods approached to understanding why parents choose Montessori education. Retrieved from http://www.eric.ed.gov/ERICWebPortal/search/recordDetails.jsp?ERICExtSearch_SearchValue_0=ED516180&searchtype=keyword&ERICExtSearch_SearchType_0=no&_pageLabel=RecordDetails&accno=ED516180&_nfls=false&source=ae

Zinzeleta, E., & Little, N. K. (1997). How do parents really choose early childhood programs? Young Children, 52(7), 8-11. Retrieved from http://www.eric.ed.gov/ERICWebPortal/search/recordDetails.jsp?ERICExtSearch_SearchValue_0=EJ554438&searchtype=keyword&ERICExtSearch_SearchType_0=no&_pageLabel=RecordDetails&accno=EJ554438&_nfls=false&source=ae

A Longitudinal Examination of Parent-Adolescent Conflict, Romantic Relationship Conflict, and Depressive Symptoms among Mexican-origin Adolescent Females

Dayanna M. Reeves, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Mayra Bamaca-Colbert, Ph.D
Assistant Professor of Human Development and Family Studies
Department of Human Development and Family Studies
College of Health and Human Development
The Pennsylvania State University

Abstract

Using data from a longitudinal study on Mexican-origin female adolescents, this study examined whether mother-daughter conflict (intensity and frequency) at Wave 1 predicted adolescent depressive symptomatology at Wave 2 and examined the possible mediating role of romantic relationship conflict. A total of 100 participants had complete data on the variables of interest. Results indicated that conflict intensity with mothers at wave 1 predicted romantic relationship negativity at Wave 2 and depressive symptoms at Wave 3. Contrary to expectations, romantic relationship conflict did not predict depressive symptoms at Wave 3. Findings point to the importance of the mother-daughter relationship in predicting adjustment.

The emotional context of the relationship with parents and adolescent romantic partners can ultimately affect adolescent psychological well-being. Specifically, research suggests that less supportive parenting can affect the psychological well-being of the child and that family conflict is a predictor of depression in adolescents (Sheeber et al., 1997). The quality of relationships with romantic partners can also affect adolescents' psychological well-being. Research shows that adolescents who experience stress in romantic relationships report higher levels of depressive symptoms (La Greca & Moore, 2005). Overall, most of our understanding on the link between parent-adolescent and romantic relationship factors has been based on the mainstream work with White adolescents and their families. Latinos are the largest growing ethnic minority group in the US (US Census, 2010) and depression during adolescence is a serious public health issue. Therefore, it is important that we examine predictors of depression among this population. The purpose of the current study was to examine the link between parent-adolescent conflict and relationship quality with romantic partners in predicting depressive symptomatology. Specifically, we tested whether romantic relationship negativity would mediate the relation between parent-adolescent conflict and depressive symptoms in a group of Mexican-origin middle and late adolescent females.

Depression

Adolescence is an important developmental time period where changes occur physically, mentally, and socially (Yurgelun-Todd, 2007). During this time, there is an increase in mental health problems. For instance, national school-based figures indicate that 16% of adolescents report being sad or having had thought about suicide (Child Trends, 2012). In addition, suicide is the third leading cause of death among adolescents ages 15-19, with Hispanic females being more likely to report these patterns than other ethnic groups (Child Trends, 2012). Particular to this study, research suggests that depression is a common mental health disorder in adolescence that predicts serious risks in adulthood (Sampson & Mrazek, 2001). Some consequences of depression in adolescence include poor peer relationships, academic failure, and behavioral issues (Hauenstein, 2006).

There are major sex differences in relation to depression. Depression is known to affect females more often than males (Hammen, 2003). Although there is no one variable that explains the gender differences in males and females, research suggests that women experience more victimization, stressful life events, and chronic strains, which may explain these differences (Nolen-Hoeksema, 2001). During adolescence, females respond to stress more frequent than males by focusing internally on personal problems and feelings, a pattern that continues throughout adulthood, which can predict future depression outcomes (Hammen, 2003). This sex gap has also been reported among Latino samples, including Mexican-origin (Marsiglia, Kulis, Perez, & Parsai, 2011). Therefore, having a better understanding of the factors that predict depressive symptoms among Mexican-origin females is imperative. One aspect that has been linked to depressive-related problems among females is the interpersonal context.

Attachment Theory

Formally linked to infant development, attachment is now an important area of study for later development. Attachment theory states that forming secure/supporting attachments play a role in shaping the life of an infant (Lopez, 1995). Secure/warm relationships early in life seem to predict similar relationships as a child develops and grows (Collins, Welsh, & Furman, 2009). On the other hand, individuals who experience negative family interactions as children often suffer from depressive symptoms and poor social relationships during adolescence (Sheeber, et. al, 1997). Overall, the literature shows that attachment is an ongoing process and plays an important role in adolescent adjustment (Lopez, 1995). Attachment theory highlights the connection between individuals' relationship with parents and relationships with others, with the quality of the parent-adolescent relationship believed to affect many other aspects of adolescents' social relationships (Rubin, Dwyer, Booth-LaForce, Kim, Burgess, & Rose-Krasnor, 2004). Thus, in this study we looked at the interconnection among parent-adolescent conflict, romantic relationship conflict, and depressive symptomatology.

Parent-Adolescent Conflict

Parental practices are an important influence on adolescent's adjustment and youth development (Doyle & Markiewicz, 2005). Adolescents develop a desire for autonomy, which creates discrepancies in the parent-child relationships and can lead to increased conflict (Collins, 1997; Fuligni, 1998). Most conflict can affect individuals' psychological well-being, whether it is via experiencing more anxiety, depression, or stress (Abbey, Abramis, & Caplan, 1985; Shek,

1998). In addition, family conflict appears to be particularly important during adolescence (Conger, R., Ge, X., Elder, G., Lorenz, F., & Simons, R. (1994). Research suggests that puberty and generation gaps have been reported to cause conflict between parents and adolescents (Montemayor, 1983).

Earlier work on family conflict and its contribution to adolescent well-being focused on marital conflict and divorce (Amato, 2000; Doucet &Aseltine, 2003). Research in this area showed that marital conflict and divorce produced depression and secondary problems within a family. Such problems include economic issues, long-term conflict between mother and father, and disorganization among family (Doucet & Aseltine, 2003). More recently, parent-child conflict has been implicated with the development of conduct problems and depression during adolescence (Jenkins, Goodness, & Buhrmester, 2002). Parent-adolescent conflict has been linked to stress, which can cause depression in adolescence (Montemayor, 1986). This may partially explain why conflict is linked to adolescents' mental state.

Along these lines, parent-adolescent conflict has been associated with Latino adolescents' psychological development, including depressive symptoms and internalizing problems (Loukas & Roalson, 2006; Crean, 2008). Research suggests that conflict predicts psychological symptomatology and school competencies among Latino adolescents (Crean, 2004). Furthermore, previous research suggests that parent-adolescent conflict is not only linked to adolescent well-being, but can contribute to how individuals act in their peer relationships (Collins, 1997). Therefore, it is important to examine parent-adolescent conflict in the presence of other important interpersonal domains such as romantic relationships and how these relate to adjustment when examined together.

Romantic Relationships

Given the prevalence of romantic relationships during adolescence, it is important to examine this interpersonal context in relation to youth development and adjustment. Romantic relationships become more meaningful as adolescents get older (Collins, 2003; Collins, Welsh, & Furman, 2009). Romantic Relationships is a term that is not explicitly clear in the literature. Researchers define "romantic relationships" as a relationship that involves affection, sharing of feelings, and sexual behaviors (La Greca & Moore, 2005). In addition to romantic relationships there is also "Romantic experiences" which refers to broader experiences such as crushing, hooking up, being in a relationship or having sexual intercourse (Collins, Welsh, & Furman, 2009). This can cause confusion in the understanding of romantic relationships and their contribution to adjustment. For the purpose of this study, we will be examining romantic relationships in relation to conflict.

The quality of romantic relationships has an effect on youth development (La Greca, & Moore, 2005). Relationship quality refers to the level of intimacy, support, and nurturance one offers (Collins, Welsh, & Furman, 2009). Low quality relationships are associated with conflict and negativity, while high quality relationships are associated with warmth and support (Collins, Welsh, & Furman, 2009). In general different aspects of romantic relationships have been linked to adolescent adjustment. Specifically, research shows that short-term relationships during adolescence are associated with depressive symptoms (Joyner & Udry, 2000). Social anxiety has also been linked to depressive symptoms in adolescent romantic relationships and peer groups (La Greca & Moore, 2005). A study conducted by Kim and Capaldi (2004) showed that

romantic partners influenced one another's moods suggesting that males psychological aggression contributed to female depression symptoms. This study also concluded that antisocial behavior in the relationship contributed to depressive symptoms.

Recent literature has examined romantic relationship conflict in the context of attachment styles. Research suggests that the style of attachment is associated with the amount of conflict that occurs in the romantic relationship (i.e., anxiously attached individuals experience more conflict with their romantic partner) (Campbell, Simpson, Boldry, & Kashy, 2005). A study done by Joyner and Udry (2000) suggested that females are more vulnerable to romantic experiences than males and, therefore, suffer from depressive symptoms. Another study suggests that insecure attached individuals report more negative conflict during arguments, whereas securely attached people report less conflict (Creasey & Hesson-McInnis, 2001).

The Current Study

On the basis of existing literature we proposed four hypotheses. All analyses controlled for adolescent age, pubertal development, and depression at Wave 1.

Hypothesis 1: Conflict with parents at Wave 1 would significantly predict females' depressive symptoms at Wave 3 and romantic relationship conflict at wave 2.

Hypothesis 2: Conflict with parents at Wave 1 would predict romantic relationship negativity at Wave 2.

Hypothesis 3: Romantic relationship negativity at Wave 2 would predict depressive symptoms at Wave 3.

Hypothesis 4: Romantic relationship negatively would partially mediate the association between conflict with parents at Wave 1 and depressive symptoms at Wave 3 such that this relationship would decrease once romantic relationship negativity at Wave 2 is entered into the regression model.

Methods

Participants

Participants for this study (n = 100) were part of a larger, longitudinal project on Mexican-origin females recruited from a Southwestern, metropolitan area in the U.S. Participants were early to mid-adolescents at Wave 1 and mid-late adolescents at Wave 3 of the study. The original sample contained 338 female adolescents (and 319 mothers) of which 321 (95%) indicated their interest in a follow-up study. The follow-up was conducted two and a half years later with the adolescent sample only. During the Wave 2 recruitment phase, a total of 201 females were reached. A total of 194 adolescents agreed to participate and 7 declined. Of these, 153 (47.6% of the original 321 interest in the follow-up) completed surveys at Wave 2. At Wave 3, a total of 170 females agreed to participate of a total of 180 who were reached. Of these, 146 (45.4% of the original 321 interest in the follow-up) completed the survey at Wave 3. Of the adolescents who indicated interest in a follow-up at Wave 1, but did not participated at Wave 2

(*n* = 168) or Wave 3 (n = 175), about 80% were not able to be contacted due to disconnected or wrong phone numbers, with the remainder not returning the survey or refused to participate in the follow-ups. A total of 124 participants were retained across the 3 waves. Of these, 100 participants had complete data for the variables of interest to the current study.

Procedure

Families were recruited for this study on a voluntary basis. At Wave 1, school personnel mailed letters to families asking that informational sheets be returned if families were interested in participation. Eligibility requirements included: being a female of Mexican ethnicity attending 7th grade or 10th grade with a mother figure willing to participate. Documents not originally available in Spanish were translated and then translated back by a Mexican researcher. Data was collected from adolescents in the classroom, at lunch and after school. The mothers participated in a phone interview, in their language of preference. For a more detailed description of the procedure please refer to Author's citation.

During Waves 2 and 3, research assistants contacted participants and/or their mothers by phone, mail, or e-mail to invite them to participate in a follow-up study. Research assistants followed informed consent procedures and obtained oral consent from mothers (if participants were minors) and consent from participants. Participants who agreed to participate received a survey in their language of choice by mail. They then completed the survey and mailed it back inside of a pre-paid envelope. Adolescents received monetary compensation ($20 for Wave 2 and $25 for Wave 3) for completing the survey. Over 88% of participants completed the survey in English.

Measures

Mother-daughter conflict. At Wave 1, a 15-item measure was used to assess the frequency and intensity of conflict within the parent-daughter dyad. Adolescents were given a list of possible areas of argument with their parents and were asked to indicate how often (for frequency) or how intense or angry (for intensity) they got during these arguments with their parent about each of 15 domains (e.g., physical appearance, friends, and romantic relationships). Participants responded to the frequency items using a 5-point Likert scale, with end points of *Never* (1) to *Most of the time* (5) and to the intensity items using a 5-point Likert scale, with end points of *Very mild* (1) to *Very angry* (5). Items were averaged for a total conflict score with higher values indicating more frequent or intense conflict.

This measure was developed by Smetana (1988) and modified to include items that were specific to Mexican American families, including issues such as putting family first and talking back to parents (Updegraff, Delgado, & Wheeler 2009). A previous version (12-items) demonstrated high reliability and validity in a study of Mexican American families (α = .70-.88; Thayer, 2004). Updegraff, Delgado and Wheeler (2008) obtained alphas of .84 for mothers and .87 for fathers in a sample of Mexican origin families.

Depressive symptomatology. Adolescents completed The Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977) in order to examine how often participants experienced depressive symptoms within the last week (e.g., "I felt people disliked me." "I felt lonely." and "I had crying spells."). This measure is used to examine the prevalence of

depressive symptoms in the general population (Golding & Aneshensel, 1989). Participants were asked to respond to 20 statements on a 4-point Likert scale with end points of 0 = rarely or none of the time (less than 1 day) and 3 = mostly or almost all the time (5-7 days). Reverse codes were given to positive worded items. All items were averaged to represent an overall depressive symptoms score. The CES-D has obtained acceptable reliability scores (.91) with Latino samples (e.g., Umana-Taylor &Updegraph, 2002).

Pubertal development. We controlled for adolescents' pubertal development at Wave 1 with the five item Pubertal Development Scale (PDS, Peterson, Crockett, Richards, & Boxer, 1988), which assessed changes during puberty (e.g., skin, growth in height, changes/acne). This scale has shown moderate reliability and validity (e.g., $\alpha = .75$ for boys and girls, Siegal, Yancy, Aneshensel, & Schuler, (1999) with minority samples including Latino adolescents. The 5-item scale obtained an alpha coefficient of .61 with the current sample.

Results

The purpose of this study was to examine whether romantic relationship conflict would mediate the association between conflict with parents and depressive symptomatology. To achieve this goal, a series of regressions were run to examine mediation. We used the Baron and Kenny method to test for mediation, where we used romantic relationship conflict as the predicted mediator. According to Baron and Kenny (1986), three relationships must be established to establish mediation. The first relationship must link the independent variable (IV) to the mediator. Second, the mediator should be related to the dependent variable (DV). Finally, the relationship between the IV and the DV should decrease when controlling for the mediator.

Based on our understanding of the relation among parent-adolescent conflict, romantic relationship conflict, and depression, we proposed a model to explain the association between conflict frequency/intensity with mothers as it relates to romantic relationship conflict and depression. More specifically we hypothesized that (a) conflict frequency/intensity with mothers would predict romantic relationship conflict, (b) romantic relationship conflict would predict depression, (c) conflict frequency/intensity would predict depression, and (d) romantic relationship conflict would partially mediate the association between conflict with parents and depression.

The first regression tested the relationship between conflict frequency/intensity and romantic relationship conflict. Results indicated that conflict frequency with mothers at wave 1 was not a significant predictor of romantic relationship conflict at wave 2. On the other hand, conflict intensity with mothers at wave 1 was a predictor of romantic relationship conflict at Wave 2 ($p = .012$). The second regression tested the relationship between romantic relationship conflict at wave 2 and depression at wave 3. This relationship was not proven to be significant when examined in the context of conflict frequency. However it was significant when examined in the context of conflict intensity. The third regression examined whether conflict frequency/intensity with mothers at wave 1 would predict depressive symptoms at wave 3. Results indicated that both conflict frequency and intensity with mothers was a significant predictor of depressive symptoms. The fourth regression tested for mediation, where we examined the relationship between conflict frequency/intensity as it relates to depression while

taking into account the conflict experienced in the romantic relationship. Results indicated that the predicted mediator romantic relationship conflict did not show any significance when examining it in the context of conflict frequency or intensity (see Figures 1 and 2 for a summary of the regression beta's obtained).

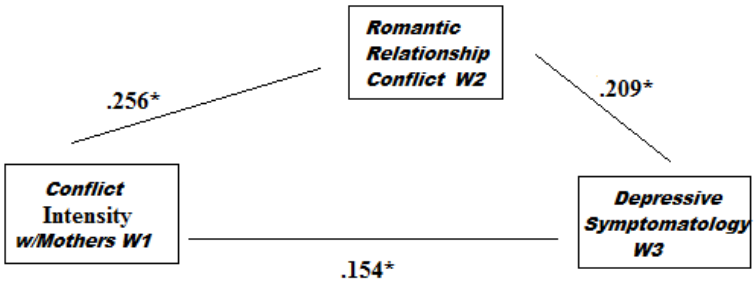


Figure 1. Model that included conflict intensity with mothers. Control variables included depression at wave 1, adolescent age, and pubertal development. *p <.10, **p <.05

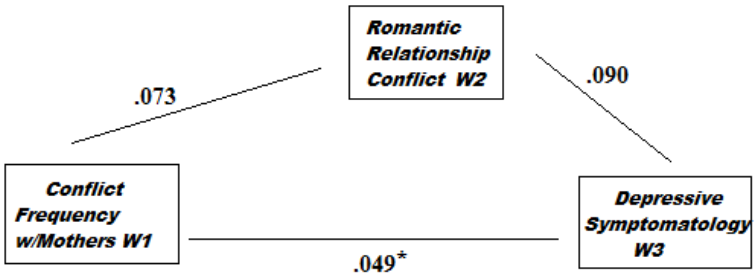


Figure 2. Model that included conflict intensity with mothers. Control variables included depression at wave 1, adolescent age, and pubertal development. *p <.10, **p <.05.

In summary, the results of the mediational analysis did not support the role of romantic relationship conflict in accounting for the relation between parent-adolescent conflict and depressive symptoms. When examining the relationship between romantic relationship conflict and depression by itself, results prove to be significant. However, when examining this relationship in the context of conflict with parents and depression it did not show significance.

Discussion

We took a mediational approach to examine the relationship between parent-adolescent conflict frequency/intensity and depressive symptoms by taking into account romantic relationship conflict. After controlling for adolescent age, pubertal development and depressive symptoms at wave 1, our findings suggest that conflict within a romantic relationship at Wave 2 directly predicted depressive symptoms at Wave 3, but only when frequency of conflict with

parents was in the model. However, conflict with a romantic partner did not mediate the association between parent-adolescent conflict frequency or intensity at Wave 1 and depressive symptoms at Wave 3. Moreover, our findings highlight the salience of conflict intensity with parents in predicting depressive symptoms 3 ½ years later, at Wave 3. Findings also suggest important directions for future research.

When examining the direct link between conflict frequency/intensity with mothers and romantic relationship conflict, findings indicated that only conflict intensity with mothers was a significant predictor of romantic relationship conflict, not conflict frequency. Furthermore, results indicated that conflict intensity with mothers was a significant predictor of depression, not conflict frequency. Thus, these findings suggest that the level of intensity experienced while arguing with parents is more detrimental to adolescents' well-being than just the frequency with which parents and adolescents argue with each other. Overall, the more intense the arguments with mothers were reported at Wave 1, the more likely females in our sample reported more conflict within the romantic relationship at Wave 2 and depressive symptoms at Wave 3. Interestingly, in this model, conflict within the romantic relationship did not predict depressive symptoms a year later. It is possible that the negative quality of the relationship with parents is a better predictor of depression because of the importance of family emphasized in Latino cultures.

When examining the relation between romantic relationship conflict and depressive symptoms alone, results were significant. However, when examining romantic relationship conflict as a mediator between conflict with parents and depression, the relationship was not significant. This finding may be explained by stating that the intensity of conflict with parents was such a strong predictor of depression that it did not allowed for romantic relationship conflict to account for any additional variance in the model. Also important to note is that our sample size was small limiting our power to find a significant mediating effect. Overall these longitudinal findings lend support to the suggestion that conflict with parents play a role in adolescent's psychological adjustment. Specifically the intensity of conflict seems to be a strong predictor of depression.

Several methodological limitations dictate that one is careful before drawing conclusions based on these results. First, the sample size for the variables of our choice was quite small. Given the nature of our focus on romantic relationships, we were limited to data from adolescents who reported having had a relationship within the last year at Wave 2; many adolescents did not have complete data for the romantic relationship measure. We were also limited in not having available data on romantic relationships at baseline. At waves two and three, questions related to experiences within a romantic context were included in the questionnaires and during this time there were many adolescents who did not report on their romantic relationships. Either they did not have a romantic partner or they choose not to respond. Also, all of this data was based on self-report questionnaires. Despite this weakness, we reasoned that the sample size would not jeopardize the validity of our results completely. It may be useful to replicate this study using observational based measures to help the validity of these results. Further, future research should examine potential moderators that can inform the lack of significant mediation. A potential moderator is adolescent's age. It is possible that mediation exists for older adolescents, but not younger ones whose romantic relationships have not achieved as much depth as those of older ones.

Despite these limitations, the results reported above (a) suggest that conflict intensity plays a role in predicting romantic relationship conflict; (b) imply that conflict intensity is a factor when predicting depression long-term; (c) suggest that the conflict frequency is not as important as conflict intensity when predicting depressive symptomatology and (d) highlights the importance of continuing to look for other factors that predict adolescent depressive symptoms such as peer relationships, and substance use.

References

Abbey, A., Abramis, D. J., & Caplan, R. D. (1985). Effects of different sources of social support and social conflict on emotional well-being. *Basic and Applied Social Psychology, 6, 111-129.*

Amato, P.R. (2000). The Consequences of Divorce for Adults and Children. *Journal of Marriage and Family, 62(4), 1269-1287.*

Campbell, L., Simpson, J. A., Boldry, J., & Kashy, D. A. (2005). Perceptions of Conflict and Support in Romantic Relationships: The Role of Attachment Anxiety. Journal of Personality and Social Psychology, 88, 510-531.

Child Trends (July, 2012). *Suicidal Teens*. Retrieved from www.childtrendsdatabank.org/?q=node/128

Collins, A. W., Welsh, D. P., & Furman, W. (2009). Adolescent Romantic Relationships. *Annual Review of Psychology, 60, 631-652.*

Collins, A.W. (1997). Conflict Processes and Transitions in Parent and Peer Relationships Implications for Autonomy and Regulation. *Journal of Adolescent Research, 12, 2 178-19.*

Conger, R., Ge, X., Elder, G., Lorenz, F., & Simons, R. (1994). Economic stress, coercive family process, and developmental problems of adolescents. *Child Development, 65, 541-561.*

Crean, H. (2008). Conflict in the Latino parent-youth dyad: The role of emotional support from the opposite parent. *Journal of Family Psychology, 22, 484-493.*

Crean, H. F. (2004). Social Support, Conflict, Major Life Stressors, and Adaptive Coping Strategies in Latino Middle School Students. *Journal of Adolescent Research, 19, 657-676.*

Creasey, G. & Hesson-McInnis, M. (2001). Affective responses, cognitive appraisals, and conflict tactics in late adolescent romantic relationships: Associations with attachment orientations. *Journal of Counseling Psychology, l, 48, 85-96.*

Crick, N. R. & Dodge, K. A. (1994). A review and reformulation of social information processing mechanisms in children's social adjustment. *Psychological Bulletin*, Vol 115(1), 74-101.

Doucet, J., & Asteline, R. H. (2003). Childhood Family Adversity and the Quality of Marital Relationships in Young Adulthood. *Journal of Social and Personal Relationships, 20(6), 818-842.*

Doyle, A. B., & Markiewicz, D. (2005). Parenting, marital conflict and adjustment from early- to mid-adolescence: Mediated by adolescent attachment style? *Journal of Youth and Adolescence*, 34, 97–110.

Fuligni, A. J. (1998). Authority, autonomy, and parent–adolescent conflict and cohesion: A study of adolescents from Mexican, Chinese, Filipino, and European backgrounds. *Developmental Psychology, 34(4), 782-792*

Hammen, C. & Brennan, P. A. (2003). Severity, Chronicity, and Timing of Maternal Depression and Risk for Adolescent Offspring Diagnoses in a Community Sample. *Archives of General Psychiatry, 3, 253-258.*

Hauenstein, E. J. (2006). Depression in adolescence. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, 32, 239–248.

Hoeksema, S. N. (2001). Gender Differences in Depression. *Current Directions in Psychological Science, 10, 173-176.*

Jenkins, S. R., Goodness, K., & Buhrmester, D. (2002). Gender Differences in Early Adolescents' Relationship Qualities, Self-Efficacy, and Depression Symptoms. *The Journal of Early Adolescence, 22(3), 277-309.*

Doucet, J., & Asteline, R. H. (2003). Childhood Family Adversity and the Quality of Marital Relationships in Young Adulthood. *Journal of Social and Personal Relationships, 20(6), 818-842.*

Joyner, K., & Udry, J. R. (2000). You Don't Bring Me Anything but Down: Adolescent Romance and Depression. *Journal of Health and Social Behavior, 41(4), 369-391.*

(Kim, H. K. & Capaldi, D. M. (2004). The Association of Antisocial Behavior and Depressive Symptoms Between Partners and Risk for Aggression in Romantic Relationships. *Journal of Family Psychology, 18(1) 82-96.*

Kim, J.K., Conger, R.D., Lorenz, F.O., & Elder, G. H. (2001). Parent-Adolescent Reciprocity in Negative Affect and Its Relation to Early Adult Social Development. Developmental Psychology, 37(6), 775-790.

La Greca AM, Moore HH. 2005. Adolescent peer relations, friendships, and romantic relationships: Do they predict social anxiety and depression? *Journal of Clinical Child and Adolescent Psychology*,34, 49–61.

Lopez, F. G. (1995). Contemporary Attachment Theory An Introduction with Implications for Counseling Psychology. *The Counseling Psychologist, 23 (3), 395-415.*

Loukas, A., & Roalson, L.A. (2006). Family Environment, Effortful Control, and Adjustment Among European American and Latino Early Adolescents. *The Journal of Early Adolescence*, 26(4), 432-455.

Marsiglia, F. F., Kulis, S., Perez, H. G., & Parsai, M. (2011). Hopelessness, Family Stress, and Depression among Mexican-heritage Mothers in the Southwest. *Health Soc Work, 1, 7–18.*

Montemayor, R. (1986). Family Variation in Parent-Adolescent Storm and Stress. *Journal of Adolescent Research , 1, 15-31.*

Montemayor, R. (1983). Parents and adolescents in conflict: All families some of the time and some families most of the time. *Journal of Early Adolescence, 3,* 83-103.

Radloff, L. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1, 385-401.*

Rubin, K. H., Dwyer, K. M., Booth-LaForce, C., Kim, A. H., Burgess, K. B., & Rose Krasnor, L. (2004). Attachment, Friendship, and Psychosocial Functioning in Early Adolescence. *The Journal of Early Adolescence, 24(4), 326-356.*

Sampson, S. M., & Mrazek, D. A. (2001). Depression in adolescence. *Current Opinion in Pediatrics,* 13, 586-590.

Sheeber, L., Hops, H., Alpert, A., Davis, B., & Andrews, J. (1997). Family support and conflict: Prospective relations to adolescent depression. *Journal of Abnormal Child Psychology, 25,* 333-344.

Shek, D. T. L. (1998). A longitudinal study of the relations between parent-adolescent conflict and adolescent well-being. *Journal of Genetic Psychology, 159,* 53-67.

Siegal, J. M., Yancey, A. K., Aneshensel, C. S., & Schuler, R. (1999). Body image, perceived pubertal timing, and adolescent mental health. *Journal of Adolescent Health, 25, 155-165.*

Umaña-Taylor, A. J., & Updegraff, K. A. (2007). Latino adolescents' mental health: Exploring the interrelations among discrimination, ethnic identity, cultural orientation, self-esteem, and depressive symptoms. Journal of Adolescence, 30(4), 549-567.

Updegraff, K. A., Delgado, M. Y., & Wheeler, L. A. (2009). Exploring mothers' and fathers' relationships with sons versus daughters: Links to adjustment in Mexican immigrant families. Sex Roles, 60, 559-574.

Updegraff, K. A., Madden-Derdich, D. A., Estrada, A.U., Sales, L.J., & Leonard, S. A.(2002). Young Adolescents' Experiences with Parents and Friends: Exploring the Connections. Family Relations, 51, 72-80

Yurgelun-Todd, D. (2007). Emotional and cognitive changes during adolescence. *Curr Opin Neurobiol*, *17*(2), 251–257.

Bayesian Inference for Bilingual Word Learning

Sebastian Rolotti, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Ping Li, Ph.D
Professor of Psychology, Linguistics, and Information Sciences and Technology
Department of Psychology
College of Liberal Arts
The Pennsylvania State University

Abstract

The indeterminacy problem describes the challenge that infants face in deciding which words refer to which objects in their environment. Bayesian models use probabilistic inferences to resolve this induction problem and show improved performance over other computational models in constructing potential lexicons and inferring speakers' referential intentions. In this study we investigate a Bayesian model's ability to learn in more complex situations, first with more objects than in previous research and then in a bilingual scenario where more than one word refers to the same object. We found that the model's absolute and relative performance was attenuated with increased complexity.

Introduction

Communication through language, even between two native speakers, can often be difficult and opaque. In an attempt to illustrate this notion, Wittgenstein says this, "Language disguises thought. So much so, that from the outward form of the clothing it is impossible to infer the form of the thought beneath it" (1922, pg. 22). For an infant with no prior access to language or understanding of social behavior, determining the intentions of speakers and the words that correspond to those intentions is doubly difficult. In his famous formulation of the problem, Quine (1960) imagines being with a foreign language speaker who points and says *gavagai* upon coming across a rabbit. Quine's indeterminacy problem, faced by infant word learners, is the problem of figuring out just what *gavagai* refers to – the rabbit itself, the rabbit's tail or ear, the whiteness of its fur, or perhaps mammals or animals in general. Of these infinite possible referents, what strategies does a word learner make use of to pick out the right one? The challenge of word-to-world mapping becomes more difficult when one considers the small proportion of words an infant hears that actually refer to objects in his or her immediate surroundings, and how irregularly those few words co-occur with those objects (Yu, 2008). With so much information to extract structure from, both Quine and Yu point out that an infant's learning system must be advantageously constrained in some way.

Constraints in Monolingual Word Learning

Despite controversies that surrounds their origins and the degree to which they are actually used, researchers for the most part agree on the need to posit a number of important assumptions that help word learners constrain a potentially infinite problem space (Markman, 1994). The *whole object constraint* assumes that words refer to whole objects instead of parts of objects. The *taxonomic constraint* assumes that novel words might be generalizable to objects that are similar to each other. The *mutual exclusivity constraint* assumes that each object has only one label (Markman, 1994). A number of similar constraints have also been posited, such as the *contrast constraint* (Clark, 1993) and the *novel-name nameless-category constraint*,(Golinkoff, Hirsh-Pasek, Bailey, & Wenger, 1992) but these constraints explore different motivations yielding mutual exclusivity, i.e. that novel words refer to novel objects (Yu, 2008; Byers-Heinlein & Werker, 2009).

There is strong behavioral evidence to suggest that monolinguals make heavy use of the mutual exclusivity constraint when deciding upon the referents of words, with the constraint developing over time through its communicative function (Davidson & Tell, 2005). The mutual exclusivity constraint appears to be available to infant word learners from at least 16 months of age (Liittschwager & Markman, 1994). It is important to note, though, that mutual exclusivity is by no means an absolute condition for word-object mapping. Yurovsky and Yu (2008) have demonstrated adult violations of mutual exclusivity in mapping a label to two distinct objects (a case of homonymy) across situations, though the constraint was used to pick an object out among co-occurring referents within individual trials. Liittschwager and Markman (1994) characterize mutual exclusivity as a 'default assumption', showing that difficulties in learning a second label for familiar objects (i.e., synonymy) disappear with enough evidence and processing capacity. They concluded that "mutual exclusivity works as a probabilistic bias and not as an absolute constraint" (pg. 957).

Parents direct somewhere between 300 to 400 utterances an hour on average to their children (Hart & Risley, 1995). With exposure to so many words over such a small time span, an intractable level of ambiguity about intended referents is likely to persist, even with the help of a number of social, linguistic, and conceptual constraints (Smith & Yu, 2008). As a means of helping to resolve this issue, Aslin and Newport (2012) point out that children are highly proficient at extracting organizational structure from ambiguous data from mere observation. The process by which children extract this information about distributions in the input is referred to as *statistical learning* (Aslin & Newport, 2012; Saffran, Aslin, & Newport, 1996). Although their probabilistic reasoning based on this information differs from that of adults (likely due to cognitive limitations), children will naturally sample these distributional properties even without the presentation of a specific task (David, Newport, & Aslin, 2009).

Computational Models

In the effort to understand the problems that word learners face and the statistical mechanisms by which these problems may be solved, computational models have

provided the ability to systematically control and manipulate relevant variables, flexibly test a range of hypotheses, and for many problems change from slow and descriptive to experimental methods (Zinszer & Li, 2010; Li & Zhao, 2012a). Whether or not these models accurately depict the processes of the cognitive system, they allow us to understand the goals and constraints faced by the system and to compare human performance to the models' optimized reasoning (Perfors, Tenenbaum, Griffiths, & Xu, 2011). Furthermore, models allow researchers to better understand the implications of their ideas, assumptions, and simplifications and thereby elaborate the phenomena under investigation to develop further questions for behavioral and neurological research. Computational models thus have a reciprocal relationship with empirical research, being informed by earlier findings and data and informing later studies (Li & Zhao, 2012a).

Existing models of word learning can generally be delineated into two classes: *hypothesis elimination* models and *associative* models (Xu & Tenenbaum, 2007a). Hypothesis elimination models generate a number of hypotheses, completely eliminating through deductive inference those that do not fit the observed data. Siskind (1996) developed an especially in-depth treatment of models of this type, presenting a formal algorithm for keeping track of only those hypotheses that provide valid potential solutions. The second class, the associative models, learn words by tracking co-occurrence or similarity statistics across situations. These co-occurrences can either be between words and objects in the environment (Roy & Pentland, 2002) or between a word and the other words in the surrounding linguistic input (Li, Burgess, & Lund, 2000). One important and broadly-applied family of associative models are connectionist networks, which map words to objects (local representations) or a group of perceptual features (distributed representations) through a form of gradient descent (Elman, 1996; Seidenberg, 1989; Li, 2009; see Li and Zhao 2012b for review). Among other domains, connectionist models have successfully simulated several phenomena of bilingual word learning, reviewed below.

As a means of evaluation, Xu & Tenenbaum (2007a) introduce five core word-learning phenomena that must be replicated by any valid computational model: (1) learning inductively from very few examples, (2) learning from only positive examples, i.e., they are never told what words do *not* refer to, (3) learning a system of overlapping concepts, (4) learning word meanings in a graded fashion, with varying degrees of confidence depending on the number and quality of examples available, and (5) learning based on intentional reasoning and how the examples are being generated. Xu and Tenenbaum go on to evaluate each class of models for each of these criteria, concluding that neither is capable of succeeding in all five areas. The use of connectionist models has also been critiqued because of the opacity of the networks' solutions; more generally, researchers have questioned the wisdom of bottom-up approaches such as these when so little is known about the degree to which they accurately model the physiological mechanisms of the brain (Griffiths, Chater, Kemp, Perfors, & Tenenbaum, 2010).

Bayesian Models

Frank, Goodman, & Tenenbaum (2009) introduce another distinction between *social intentional* theories which emphasize a rich understanding of speakers' intentions to learn

words, and *cross-situational* approaches, the foundational underpinning of most computational models, which depend largely on co-occurrence, viewing speakers' intentions as ambiguous noise to be canceled out through multiple observations. In order to bridge the gap between these two theoretical approaches, Frank et al. (2009) propose that the learning of words and intentions be combined into a single joint-inference problem, to be solved with a new class of Bayesian inference models. Models of this type have been shown to be capable of accounting for all five of the core word learning phenomena (Xu & Tenenbaum, 2007a) and in comparison tests have been shown to outperform a number of models belonging to the other two classes in developing a lexicon and figuring out speakers' intentions (Frank et al., 2009). The same study also demonstrated this model's capability to display a number of behaviorally realistic learning phenomena, such as graded mutual exclusivity and *fast mapping*, or learning an object-label association from a single observational trial.

Bayesian models are similar in principle to hypothesis elimination models, except that they evaluate hypotheses probabilistically. All hypotheses are considered, with each being assigned a *posterior probability*, indicating the model's degree of belief in that specific hypothesis (Perfors et al., 2011). Instead of eliminating any hypotheses, the model assigns smaller and smaller probabilities to the more unlikely hypotheses. Posterior probabilities across all hypotheses must sum to one, in accordance with the *principle of conservation of rational belief* (Xu & Tenenbaum, 2007a; Perfors et al., 2011), requiring that more confidence in one hypothesis is balanced by a lower degree of confidence in others.

The posterior probability $p(H_i|D)$ of a hypothesis H_i given data D, can be calculated according to Bayes' Rule:

$$p(H_i|D) = \frac{p(D|H_i)p(H_i)}{\sum_j p(D|H_j)p(H_j)}$$

Here $p(D|H_i)$ is known as the *likelihood probability*, while $p(H_i)$ is known as the *prior probability*. The likelihood probability captures how much one would expect to observe the data D if H_i were true, while the prior captures how likely hypothesis H_i is before observing any data at all. The hypothesis space from which the hypotheses and their associated prior probabilities are drawn from is structured in accordance with the modelers' assumptions about the word learning principles and constraints available to the model (Xu & Tenenbaum 2007a). For example, hypotheses with smaller lexicons or lexicons that do not give two labels to the same object in accordance with the mutual exclusivity constraint may be allotted a higher prior probability. The product of the likelihood and prior expresses a trade-off between how well the hypothesis, in our case a lexicon, fits the observed data on the one hand and how inherently complex the lexicon is on the other (Perfors et al., 2010). The better the fit and the simpler the hypothesis, the higher the probability that it is the right one. The denominator in the above expression normalizes the term, ensuring that the probabilities sum to one. While this expression represents an evaluation of the hypotheses, how they are generated from a possibly infinite hypothesis space is another model-dependent question to be addressed below.

Of great importance in Bayesian inference are the related notions of the *size principle* and *suspicious coincidence*. The size principle dictates that smaller hypotheses assign greater likelihood probabilities than do larger hypotheses, and this difference becomes exponentially large as the data set upon which the hypotheses are based increases (Xu & Tenenbaum, 2007a). This is more clearly expressed through the intuitive notion of suspicious coincidence, whereby the model is sensitive to the way data are being generated, assuming for the most part that the objects to be labeled are random, representative samples of referents for that word. As a result of this assumption, the smallest hypothesis that fits the data becomes the most attractive. For example, after the native in Quine's (1960) example points to the rabbit and says *gavagai*, the word learner will probably assume it refers to the rabbit and not to all animals or living things, but his or her level of certainty in that assumption would be rather low. After coming across two more rabbits and hearing the same label while other animals do not receive that name, the word learner should become more certain of the correspondence between *gavagai* and rabbits. If the word did truly refer to all animals, it would be a suspicious coincidence that of all the animals that could have been randomly selected and presented in association with *gavagai*, all three would be rabbits. This type of *graded generalization* is characteristic of human word learners, providing a partial solution to the problem of no negative evidence (Perfors et al., 2011), and is an important feature of Bayesian models that distinguishes them from previous model classes (Xu & Tenenbaum, 2007b).

Behavioral Evidence for Bayesian Models

Bonawitz & Griffiths (2010) indicate that current research proposes that inductive problem solving of the type found in word learning is Bayesian in character. Xu & Tenenbaum (2007a) presented 3-4 year old children with either one or three similar objects and a single associated label, asking them to either pick out other objects that would also be named by that label or to judge whether a newly presented object would fit with that label. They found in both cases that in the three-object trial the children tended to generalize the name to refer to less similar objects significantly less often than in the one-object trial, indicating that the children were reasoning with the notion of suspicious coincidence in mind and narrowing in on the most specific valid hypothesis given more data. That is, children shown only one instance of a 'dog' may be willing to generalize the word to a cat or bear, but after observing three examples of a 'dog' children would tend to associate the word 'dog' with more specifically dog-like qualities and expect cats and bears to have a different label. Xu & Tenenbaum (2007b) further demonstrated the Bayesian nature of word learning by finding that four year olds only changed their generalizations according to suspicious coincidence in this way when they had reason to believe the sampling of objects was representative of the entire space of referents for a label, i.e., chosen by a "teacher" (*strong sampling*) instead of picked out by some other accidental, less representative process, i.e., chosen based on similarity to previously labeled referents (*weak sampling*), indicating a sensitivity to the data generation process.

A number of studies have also shown the cognitive plausibility of models of this type. Adults and 12-14 month old children have been shown capable of tracking co-occurrence statistics over a number of ambiguous trials of multiple-word to multiple-

object pairings to systematically learn an entire lexicon of word-referent mappings (Yu & Smith, 2007; Smith & Yu, 2008). These results are partly explained by a demonstrable ability, at least in adults, to use partial knowledge from preceding situations to not only better learn labels for previously presented objects, but also to constrain the name possibilities of novel objects to support the systematic learning of an entire lexicon (Yurovsky, Fricker, Yu, & Smith, 2010). The systematic nature of lexicon learning is represented in the model considered in this paper by its comparative evaluation of whole lexicons instead of single word-object mapping entries in the lexicon. Vouloumanos (2008) established the plausibility of keeping track of and considering the probability of a number of candidate word-referent mappings with a high degree of exactness, even when those mappings were extremely unlikely. A graded version of constraints such as mutual exclusivity is therefore more likely to represent human word learning than the strictly discrete all-or-nothing constraints reflected in previous hypothesis generation models.

Bilingual Word Learning

While models of monolingual word learning abound, less work has been done to model bilingual word learning (Li & Zhao, 2012a), a process which fosters the development of a different set of word learning skills, constraints, strategies, and expectations (Merriman & Kutlesic, 1993; Bialystok, Barac, Blaye, Poulin-Dubois, 2010). Davidson and Tell (2005) explain that use of the mutual exclusivity constraint might be problematic for bilinguals who, if adhering to this assumption, would be hesitant to assign another name to an object previously labeled in another language, though this would be necessary to properly learn two languages. They found that bilingual children are much less likely to depend on the mutual exclusivity constraint than monolinguals, who make use of it in nearly all cases, particularly as they get older. Byers-Heinlein and Werker (2009) suggest that the acquisition of translation equivalents for bilinguals and trilinguals precedes the development of mutual exclusivity, and that the number of these equivalents in a lexicon is likely related to the degree to which mutual exclusivity is obeyed. Au and Glusman (1990) demonstrated, though, that both monolingual and bilingual five year olds readily accepted two labels for an object when the names explicitly came from different languages, indicative of a sensitivity to sampling and a graded sense of mutual exclusivity (Xu & Tennenbaum, 2007b). While there is research to show an early language differentiation in pragmatic abilities and in the organization of the lexicon (Paradis, 2001), it remains to be seen how early and through what means monolingual and bilingual infants are able to distinguish the language origin of different words, and when and to what degree this knowledge facilitates bilingual word learning (Byers-Heinlein and Werker, 2009; Perfors, 2001). The model discussed in this paper therefore makes no assumptions regarding the infant word learner's linguistic meta-knowledge (although such knowledge could be highly important in guiding bilingual learning).

Research has also shown that while the course and rate of language development for monolingual and bilingual children are similar, the lexicon of bilingual children in each language is smaller than that of a comparable monolingual (Bialystok et. al, 2010), though the bilingual may know the same or more words when both languages are taken into account (Byers-Heinlein and Werker, 2009). This may be due to the division of the

bilingual's experience between two languages or due to a difference in the process of vocabulary learning (Bialystok et. al, 2010).

Models of Bilingual Word Learning

While some bilingual models of language acquisition and word learning do exist, these models typically have connectionist architectures and tend to be more concerned with the representational differences between monolinguals and bilinguals instead of the different constraints and trajectories of the word learning process (see Li & Zhao, 2012a for a brief review). Zhao and Li (2007) and Li (2009), for example, used a temporally dynamic approach to show inter- and intra-language competition effects in a self-organizing connectionist network and the consequences these effects, along with a number of word learner variables such as age of onset, have on a bilingual's lexical representation. Other self-organizing connectionist network models have given accounts of individual differences due to working memory and proficiency, priming and interference effects (Li & Farkas, 2002), critical development periods (Richardson & Thomas, 2008), and taxonomic responding and fast mapping in early word learning (Mayor & Plunket, 2010). Aside from the criticisms of connectionist models discussed earlier, Yu (2008) observes that many simulation studies of this type base themselves on artificial data that presuppose word-object pairings, failing to address the inductive mapping problem we are presently considering. Byers-Heinlein and Werker (2009) further note that no computational account has yet addressed mutual exclusivity in the multilingual situation.

Current study

To our knowledge, no studies have yet assessed the capability of Bayesian models to give a faithful depiction of the bilingual word learning process, one which is clearly different from and more complex than the monolingual case. As a first step, in this study we adapt existing computational models of monolingual language processing to the bilingual situation (Brysbaert, Verreyt, & Duyck, 2010), and, specifically, extend the findings of Frank et al.'s (2009) Bayesian intentional model, which is clearly documented and has been shown to be more effective at choosing lexicons than previous model classes. We further apply the model to a bilingual data set to assess the extent to which it is able to perform in this more complex case. Finally, we discuss the assumptions of the model which result in its varied performance in monolingual and bilingual contexts of varying complexity.

Methods

In the present study, we consider the model presented by Frank and colleagues (2009) under a new set of stimuli. In the first experiment, we modestly increase the complexity of the model's input, drawing parent-child interactions from those used by Fernald and Morikawa (1993), similar to the Rollins section of the Child Language Data Exchange System (CHILDES) used by Frank et al. (2009) (MacWhinney 2000). Using the same criteria employed in the original study, we evaluate the model's performance

and compare it to previous findings. In the second experiment, we introduce a second language by translating approximately 50% of the training material from Experiment 1 into Spanish. Again, we evaluate the model's performance on this new task and compare it with previous results.

While the original study and its corresponding supplementary material should be consulted for specifics of the model's design and implementation, we note a number of assumptions that are made for the sake of clarity. A further treatment of some of these assumptions is provided in the Discussion section, as they apply to the results of our simulations.

Model Assumptions

In order to map words to objects, we must first assume that the model is already capable of (1) parsing speech and (2) distinguishing objects in the first place. A number of behavioral results indicate that by 17 months of age, most typically developing children accomplish both of these feats, marking the approximate onset of the so-called vocabulary spurt. In a seminal paper on statistical learning, Saffran, Aslin, & Newport (1996) showed that eight month olds were able to parse and group three-syllable strings through an experience independent mechanism after only two minutes of exposure to an artificial language. The infants were able to do this by estimating and tracking the conditional or transitional probabilities of one syllable following another, parsing between low probability pairs (Swingley, 2009; Aslin & Newport, 2012). Extending these findings beyond artificial language, Hay, Pelucchi, Estes, & Saffran (2011) went on to show that 17 month olds were able to track bidirectional transitional probability statistics from two minutes of exposure to an unfamiliar natural language (i.e., Italian) to parse words and then later treat them as labels for novel objects. Infants have also been observed to discriminate familiar and novel sequences of shapes by two months (Kirkam, Slemmer, & Johnson, 2002).

Rosch et al. (1976) distinguish many levels of abstraction along the hierarchical object taxonomy, including, from low to high-level, subordinate, basic, and superordinate (e.g., "Tigger", cat, animal). Through a series of experiments, Rosch et al. show that basic objects share the largest number of common attributes, are the earliest categories perceived, sorted, and named by children, and are the most necessary and commonly used in language. Markman and Wachtel (1998) point out that basic level categories are commonly mutually exclusive, and that their use as a primary means of learning word-to-world mappings reasonably fits an assumption of mutual exclusivity. Generalization tendencies and a preference for the basic level are further explored by Xu & Tenenbaum (2007a), and in this model we assume that only basic objects are being considered by the word learner (Frank et al., 2009).

Lastly, it should be noted that while there are many possible considerations of word "meaning", including lexical co-occurrence (Li et al., 2000) and a more intensional account through groupings of distributed perceptual features (Li et al., 2007; Li 2009), "meaning" is here assumed to be extensional, i.e., the scope of the referents a label picks out (Xu & Tenenbaum, 2007a; Frank et al., 2009).

Levels of analysis

It is important to keep in mind that Bayesian models describe the strategies or approaches which may be applied when encountering new information, rather than making claims or commitments about the psychological or physiological mechanisms by which people actually learn and reason (Bonawitz & Griffiths, 2010; Bonwitz & Griffiths, 2010; Frank et al., 2009; Griffiths et al., 2010; McClelland, 2009; Xu & Tenenbaum, 2007a). Clark (1989) maintains that "explanation is…a matter of depicting the structure *at the right level*. And the right level here is determined by the need to capture *generalizations* about the phenomena picked out by the science in question" (pg. 181). Marr's (1982) Tri-Level Hypothesis classifies all information processing systems (the cognitive system included) into three levels of analysis: (1) computational, (2) algorithmic, and (3) implementational or physical. Computational analysis involves understanding the system's problems, goals, and motivations. Algorithmic analysis involves understanding the representations the system uses to solve those problems and how it goes about building and manipulating those representations. Implementational analysis involves understanding how the system's hardware functions, manifested as neurophysiological research in the cognitive case. Typically, Bayesian models of word learning should be taken as computational level models, or program explanations in the words of Jackson and Pettit(1988) and Clark (1989), that show what problems face the word learner and outlining the common features of general strategies for overcoming them (Xu & Tenenbaum, 2007a; Griffiths et al., 2010).

Model Design

As in Frank et. al (2009), the intentional model's parameters dictating the probability that words are used referentially and the probability of using words in the lexicon referentially are set to the maximum a posteriori values (the joint empirical Bayes estimate) to reduce the number of free parameters to one (the same number as the comparison models). After training, the model is scored both on the accuracy of its lexicon and on the accuracy of the inferences it makes about speakers' referential intentions. These scores are measured relative to a gold-standard lexicon and intention set generated by a human coder. The gold-standard lexicon included every noun (including plurals and baby talk, excluding pronouns) used to refer to an object at least once in the data. The gold-standard intents were based on Fernald & Morikawa's (1993) best guess as to the speakers' referents. The measures of accuracy used were *precision* (proportion of mappings made that were correct), *recall* (proportion of the total correct mappings that were found), and *F score* (the harmonic mean of precision and recall, commonly used as a standard measure of a model's degree of accuracy).

The model is compared against five other cross-situational word learning models to gauge its relative success, the first three of which are calculations of co-occurrence frequency, conditional probability, and point-wise mutual information. We also compared the Bayesian inference model to IBM Machine Translation Model I (Brown, Pietra, Pietra, & Mercer, 1994), computing association probabilities both for objects given words and words given objects. After a word-by-object matrix of association values was

attained for each model, a number of lexicons were created by considering a number of threshold values and only including word-object pairs with an association value higher than the threshold. The lexicon resulting from the threshold value that yielded the highest posterior score was kept for each model. The comparison models' intentional inferences for each situation were taken to be the objects for which a corresponding word in each model's best lexicon was uttered.

Each of the model's potential lexicons is scored based on its posterior probability, $p(L|C) \propto p(L) \times p(C|L)$, found by calculating the product of the prior and likelihood probabilities. The prior probability is calculated according to a parsimony assumption, awarding each lexicon L_i a score inversely proportional to its size:

$$p(L_i) \propto e^{-\alpha|L_i|}$$

The likelihood function, which calculates the probability $p(C|L_i)$ of observing the corpus of situations given a lexicon, is based on a number of interdependencies and assumptions. For the objects O_s , intentions I_s, and words W_s in each situation S, we assume that I_s is a subset of O_s, and that every subset is equally likely to be intentionally referred to, i.e., $p(I_s|O_s) \propto 1$. We further assume that given I_s, a speaker's utterance W_s depends upon both I_s and the lexicon L. We also assume that speakers have a certain probability γ of using a word referentially in any given context. We finally consider two distinct probabilities: firstly, the probability $p_R(w|o,L_i)$ of choosing a word $w \in W_s$ uniformly at random from the set of valid labels to refer to a given object $o \in O_s$ with lexicon L_i, and secondly, the probability $p_{NR}(w|L_i)$ of choosing a word to be used non-referentially. A parameter κ dictates how likely words in the lexicon are to be used non-referentially relative to words outside the lexicon (i.e., because we choose $\kappa < 1$, words in the lexicon are less likely to be used non-referentially). As our final likelihood probability we get:

$$p(C|L_i) = \prod_{S \in C} \sum_{I_s \subseteq O_s} \prod_{w \in W_s} \left[\gamma \cdot \sum_{o \in I_s} \frac{1}{|I_s|} p_R(w|o, L_i) + (1-\gamma) \cdot p_{NR}(w|L_i) \right]$$

Hypotheses for potential lexicons are generated stochastically: new lexicons are always chosen over old lexicons if they yield a greater posterior score, but are chosen with a probability equal to the ratio of the lexicon's scores otherwise. New lexicons are generated by adding a word-object pairing, deleting a pairing, or swapping two pairings according to a data-driven Markov-Chain Monte Carlo strategy. Because of the irregularity of the posterior score distribution, incremental moves in the right direction may actually temporarily yield severely worse posterior scores. The lexicon space is therefore searched stochastically via a Monte Carlo strategy known as simulated tempering whereby a number of searches with differing degrees of greediness are run in parallel. The model's search and scoring process typically converges to its final posterior value within 10k-50k moves.

Simulation 1

In the first simulation we extend the monolingual Bayesian word-learning simulation of Frank et al. (2009), using a new data set from similarly annotated transcriptions (Fernald & Morikawa, 1993) of English-speaking mothers interacting with their infants. This data set is compiled to provide a corpus comparable in size and complexity to the corpus used by Frank et al. (2009), see Table 1 for comparison.

Table 1

Size and Complexity Comparisons Between Past and Current Datasets

	Frank et al. (2009)	**Current Monolingual Study**	**Current Bilingual Study**
Size			
Object types	22	22	22
Word types	419	321	486*
Object tokens	1261	1671	1671
Word tokens	2507	2106	2019
Total situations	619	571	571
Complexity			
Average words per situation	4.0501	3.6883	3.5359
Average objects per situation	2.0372	2.9264*	2.9264*
Average words per object per situation	2.5987	1.5252*	1.4492*

Note. * indicates a significant difference from previous studies. In this case the presence of approximately one more object per situation on average produces a slightly more complex set of situations, predicting decreased performance.

Simulation 2

In the second simulation, the same model is trained on bilingual input. Approximately 50% of the utterances from the monolingual corpus were translated into Spanish, with transparency (i.e., the translation's Spanish nativeness) being chosen over fidelity (i.e., the extent to which the translation accurately renders the meaning of the English) whenever possible. Besides language differences, the bilingual corpus is similar in size and complexity to the corpus in Simulation 1, as can be seen in Table 1. The only significant difference between the corpora is the significantly larger (51%) number of word types in Experiment 2, a result that is expected from the use of two languages and by extension the common use of two words to designate the same concept. After training, the same accuracy ratings used in Simulation 1 are re-applied in Simulation 2.

Results

Simulation 1

The Bayesian intentional model was run 20 times, and its precision, recall, and *F* score were recorded after each run. After averaging these scores across all the runs, the results indicated that the model outperformed the comparison models in building a lexicon from the child-directed speech situations. As can be seen in Table 2, the intentional model had the highest precision value, .40, and the highest *F* score value, .35. Unlike the results in Frank et al. (2009), the intentional model did not have the highest recall score in our simulations; rather, the conditional probability model had the highest recall score at .59 as compared to the intentional model at .31.

Table 2
Precision, Recall, and F *Score of the best lexicon found by each model*

Model	Precision	Recall	*F* score
Association frequency	.04	.31	.07
Conditional probability (object|word)	.04	**.59**	.07
Conditional probability (word|object)	.29	.13	.17
Mutual information	.22	.34	.27
Translation model (object|word)	.15	.31	.20
Translation model (word|object)	.24	.38	.29
Intentional model	**.40**	.31	**.35**

Note. The highest values obtained are highlighted in boldface.

In contrast to findings in Frank et. al (2009), the model had no advantage in inferring speakers' intentions (Table 3), and did not have the highest value for any of the scores. The best precision was obtained by the mutual information model with a value of .56 (as compared to the intentional model's .26) and the best *F* score was obtained by the translation model with a value of .42 (as compared to the intentional model's .31). As in the previous study, the association frequency model obtained the highest recall value for the intentional inferences by a wide margin with a value of .75 (as compared to the intentional model's .39).

Table 3
Precision, Recall, and F *Score of the inferences made by each model about the speaker's referential intentions, using the lexicons scored in Table 2*

Model	Precision	Recall	*F* score
Association frequency	.14	**.75**	.24
Conditional probability (object|word)	.16	.61	.25
Conditional probability (word|object)	.50	.21	.30
Mutual information	**.56**	.18	.27
Translation model (object|word)	.55	.34	**.42**
Translation model (word|object)	.33	.51	.40
Intentional model	.26	.39	.31

Note. The highest values obtained are highlighted in boldface.

Table 4 displays the best lexicon found by the intentional model, which was considerably smaller than the best lexicons found by all but one other model (the translation model calculating the conditional probability of a word given an object was the only model to posit a smaller lexicon with size 14). Of the 26 lexical pairings posited by the intentional model, 13 were judged to be correct according to the gold standard. The remaining comparison models posited lexicons with sizes ranging from 50 to 500.

Table 4

Best Lexicon Found by Bayesian Intentional Model in Monolingual Simulations

Word	Object	Word	Object
hair	brush	you	face
flashlight	**flashlight**	**waffles**	**waffles**
dough	**dough**	under	pepperoni
doors	car	the	face
doggy	**dog**	the	dog
cheese	**cheese**	the	hotdog
brush	box	ruff	pig
brush	**brush**	**rosy**	**doll**
blocks	**blocks**	red	truck
bear	**bear**	**rabbit**	**rabbit**
bang	brush	leg	pepperoni
baby	**baby**	joey	book
alphabet	**alphabet**	**hotdog**	**hotdog**

Note. Word-object pairs judged to be correct according to the gold standard are highlighted in boldface.

Simulation 2

In Simulation 2, the Bayesian intentional model, while still performing highly competitively in determining a lexicon given bilingual speech situations (Table 5) only outperformed the comparison models in terms of precision with a value of .35. The association frequency model obtained the highest recall score with a value of .50 (as compared to the intentional model's .19) while the mutual information obtained the best *F* score with a value of .25 (fractionally beating out the intentional model's score). As expected, the model's best English and Spanish sub-lexicons, scored relative to the appropriate subset of the bilingual gold-standard, performed more poorly than the aggregate bilingual lexicon and more poorly than the monolingual lexicon.

Table 5
Precision, Recall, and F *Score of the best lexicon found by each model in a bilingual scenario*

Model	Precision	Recall	*F* score
Association frequency	.04	**.50**	.07
Conditional probability (object|word)	.04	.26	.07
Conditional probability (word|object)	.12	.17	.14
Mutual information	.22	.30	**.25**
Translation model (object|word)	.12	.26	.17
Translation model (word|object)	.15	.39	.22
Intentional model	**.35**	.19	.25
Intentional model (English only)	.21	.17	.19
Intentional model (Spanish only)	.25	.21	.23

Note. The highest values obtained are highlighted in boldface (differences between values may not be apparent because of rounding).

The model also performed rather poorly, both absolutely and relatively, in inferring the referential intentions of speakers (Table 6). For none of the three scoring metrics did the intentional model obtain the highest value. The best precision was, as in Study 1, obtained by the mutual information matrix with a value of .58 (as compared to the intentional model's .23) and the best *F* score was again obtained by one of the translation models with a value of .40 (as compared to the intentional model's .24). The association frequency model, as in Study 1 and in Frank et al. (2009), had the best recall score with a value of .82 (as compared to the intentional model's .25).

Table 6
Precision, Recall, and F *Score of the inferences made by each model about the speaker's referential intentions, using the lexicons scored in Table 5*

Model	Precision	Recall	*F* score
Association frequency	.15	**.82**	.25
Conditional probability (object|word)	.13	.27	.18
Conditional probability (word|object)	.43	.31	.36
Mutual information	**.58**	.17	.26
Translation model (object|word)	.48	.27	.34
Translation model (word|object)	.34	.49	**.40**
Intentional model	.23	.25	.24

Note. The highest values obtained are highlighted in boldface.

Table 7 displays the best bilingual lexicon found by the intentional model. The intentional model posited the smallest lexicon, again of size 26, with a total of 10 correct pairings. The comparison models posited lexicons with significantly more word-object pairings, ranging from 60 up to 600.

Table 7
Best Lexicon Found by Bayesian Intentional Model in Bilingual Simulations

Word	Object	Word	Object
you	face	**hotdog**	**hotdog**
you	box	guau	dog
wha	flashlight	grande	bear
the	face	**gofres**	**waffles**
the	dog	**doggy**	**dog**
the	hotdog	cheese	pepperoni
ruff	pig	cepilla	box
rosy	**doll**	**car**	**car**
queso	**cheese**	**brush**	**brush**
over	rabbit	**bloques**	**blocks**
oh	face	**bebe**	**baby**
maza	**dough**	bang	box
joey	book	a	face

Note. Word-object pairs judged to be correct according to the gold standard are highlighted in boldface.

Discussion

The use of a new monolingual English dataset yielded surprisingly different results from those obtained in Frank et al. (2009). While a number of the corpora's size metrics are similar, the smaller word token count combined with the larger object token count introduced additional ambiguity about the intended referents of each word in a situation, as compared to previous simulations. This increased complexity may have allowed the formation of spurious word-object pairs, as positive examples were less certain under the increased noise in the input. Consistent with previous results, the best lexicon found by the Bayesian model was still significantly smaller than those generated by the comparison models, owing to the bias of the prior likelihood toward parsimony. However, Table 7 reveals that, unlike the best lexicon from Frank et. al (2009), the best lexicon found in the present study contained a large number of spurious lexical items (e.g., the high frequency word 'the' was paired with the object 'dog', and the high frequency object 'face' was paired with the word 'you') despite the model's distinction between referential and nonreferential words and its bias to expect the latter. As one might expect from the low precision of the lexicon, the Bayesian model's intentional inferences based on the lexicon decreased in performance as well. Because bilingual infants have a number of other tools when discerning word meanings in realistic word learning situations (e.g., phonological, prosodic, lexical co-occurrence knowledge), in future studies we will identify the impact of removing words with obvious referents (e.g., 'you') or obvious non-referents (e.g., 'the') from the corpus, as children would most likely already have ruled these words out of the lexicon by other means.

In the next simulation, we assessed how a similarly complex but bilingual scenario affected the model's performance in building lexicons and inferring intentions when all else is held constant.

Besides a few exceptional cases, the bilingual data set yielded poorer performance than the monolingual data set for all models, and in most measures the Bayesian model was out-performed by the competing models. The best lexicon derived by the Bayesian model in this simulation contained even more obviously spurious lexical items than that of the previous simulation. Interestingly, both lexicons also contained several many-to-one word-object pairs along with a number of one-to-many (and in some cases many-to-many) word-object pairs. While any one-to-many word-object pairing is necessarily incorrect, as no two objects in the dataset have the same name, many-to-one pairs are of interest in assessing the degree to which the mutual exclusivity constraint is adhered to by the model.

As opposed to the results of Frank et. al (2009), in no case did the lexicons in either of these studies make a many-word-to-single-object pairing that was correct. While this may have been expected in the monolingual case where word learners have been found to rely heavily on the mutual exclusivity constraint (though the appearance of incorrect many-to-one pairings challenges this hypothesis), the lack of correct many-to-one pairings in the bilingual case, where the data was intended to catalyze this very type of violation, is highly problematic. The presence of these pairings in Frank et al. (2009) suggests, however, that the absence of these pairings in the current studies may be linked more to the roots of the drastic performance differences between Simulation 1 and Frank et. al (2009) than differences between learning from monolingual and bilingual inputs.

An analysis of the precision, recall, and *F* scores obtained when we score the bilingual lexicon within-language reveals some psychologically realistic results. To score the bilingual's solely English performance, for example, we removed the correct Spanish pairings made by the model from the lexicon and compared the remaining pairs (i.e., correct English pairings and any incorrect pairings) to the English subset of the gold-standard lexicon. In accordance with the literature, the bilingual's strictly English lexicon is smaller and less accurate than that of the monolingual English model (Bialystok et al., 2010). As one would expect though, the number of correct word-object pairings learned by the monolingual model and aggregate bilingual model are roughly the same, indicating similar vocabulary development trajectories.

For the most part the comparison models seem to have outperformed the Bayesian model in these more complex situations because they are unconstrained by any assumption of parsimony, and as a result they may make better use of a weak signal-to-noise ratio in the input. This advantage may decrease as the size of the corpus increases because the Bayesian model should improve in precision by excluding spurious non-referential words while the comparison models cannot do this.

Overall these simulations reveal an extreme sensitivity on the part of all models, and the intentional model in particular, to small changes in the training data. In short, our simulations in this study indicate that while the monolingual model performed comparably to the Frank et al. (2009) study, the model's absolute and relative performance was attenuated with increased complexity. While some work has here been done to define a principled way to track differences between transcriptions and datasets through comparisons of a number of size and complexity metrics, more must be done if model performance is to be reliably compared across corpora. While it appears that the Bayesian model displayed attenuated performance in the bilingual case, because of the

disparities between previous and current monolingual scores the degree and causes of this attenuation are questions for further research.

References

Aslin, R. N., & Newport, E. L. (2012). Statistical learning : From acquiring specific items to forming general rules. *Distribution*.

Au, T. K., & Glusman, M. (1990). The principle of mutual exclusivity in word learning : To honor or not to honor? *Child Development*, *61*(5), 1474-1490.

Bialystok, E., Barac, R., Blaye, A., & Poulin-Dubois, D. (2010). Word mapping and executive functioning in young monolingual and bilingual children. *Journal of cognition and development : official journal of the Cognitive Development Society*, *11*(4), 485-508.

Bonawitz, E. B., & Griffiths, T. L. (2010). Deconfounding hypothesis generation and evaluation in Bayesian models.

Brysbaert, M., Verreyt, N., & Duyck, W. (2010). Models as hypothesis generators and models as roadmaps. *Bilingualism: Language and Cognition*, *13*(03), 383-384.

Byers-Heinlein, K., & Werker, J. F. (2009). Monolingual, bilingual, trilingual: Infants' language experience influences the development of a word-learning heuristic. *Developmental science*, *12*(5), 815-23

Clark, A. (1989). Microcognition: Philosophy, cognitive science, and parallel distributed processing. Cambridge, MA: MIT Press.

Clark, E. V. (1993). *The lexicon in acquisition*. New York: Cambridge University Press.

Davidson, D., & Tell, D. (2005). Monolingual and bilingual children's use of mutual exclusivity in the naming of whole objects. *Journal of experimental child psychology*, *92*(1), 25-45.

Davis, S. J., Newport, E. L., & Aslin, R. N. (2009). Probability-matching in 10-month-old infants. *Methods*.

Frank, M. C., Goodman, N. D., & Tenenbaum, J. B. (2008). Supplementary material for "Using speakers' referential intentions to model early cross-situational word learning." *Machine Translation*, 1-16.

Frank, M. C., Goodman, N. D., & Tenenbaum, J. B. (2009). Using speakers' referential intentions to model early cross-situational word learning. *Psychological Science*, 1-8.

Golinkoff, R. M., Hirsh-Pasek, K., Bailey, L., & Wenger, N. (1992). Young children and adults use lexical principles to learn new nouns. *Developmental Psychology*, 28, 99–108.

Griffiths, T. L., Chater, N., Kemp, C., Perfors, A., & Tenenbaum, J. B. (2010). Probabilistic models of cognition: Exploring representations and inductive biases. *Trends in Cognitive Sciences*, *14*(8), 357-364. Elsevier Ltd.

Hay, J. F., Pelucchi, B., Estes, K. G., & Saffran, J. R. (2011). Linking sounds to meanings: Infant statistical learning in a natural language. *Cognitive psychology*, *63*(2), 93-106.

Jackson, F., and Pettit, P. (1988). Functionalism and broad content. *Mind, 97(387)*: 381-400.

Kirkham, N. Z., Slemmer, J. A., & Johnson, S. P. (2002). Visual statistical learning in infancy: Evidence for a domain general learning mechanism. *Science*, *83*, 4-5.

Li, P. (2009). Lexical organization and competition in first and second languages: Computational and neural mechanisms. *Cognitive science*, *33*(4), 629-64.

Li, P., Burgess, C., & Lund, K. (2000). The acquisition of word meaning through global lexical co-occurrences. *Young Children*.

Li, P., & Farkas, I. (2002). A self-organizing connectionist model of bilingual processing. In R. Heredia & J. Altarriba, Bilingual sentence processing, 17, 59–85. North-Holland.

Li, P., & Zhao, X. (2012a). Connectionist approaches to bilingual lexical representation. In J. Altarriba & R. Heredia (eds.), Understanding bilingual memory: Theory and application. Springer Science Publishers.

Li, P., & Zhao, X. (2012b). Connectionism. In M. Aronoff (ed.), *Oxford bibliographies online.* New York, NY: Oxford University Press. (www.oxfordbibliographies.com)

Li, P., Zhao, X., & Mac Whinney, B. (2007). Dynamic self-organization and early lexical development in children. *Cognitive science*, *31*(4), 581-612.

Liittschwager, J. C., & Markman, E. M. (1994). Sixteen- and 24-month-olds' use of mutual exclusivity as a default assumption in second-label learning. *Developmental Psychology*, *30*(6), 955-968.

Markman, E. M. (1994). Constraints on word meaning in early language acquisition. *Lingua*, *92*, 199-227.

Markman, E. M., & Wachtel, G. F. (1988). Children's use of mutual exclusivity to constrain the meanings of words. *Cognitive Psychology*, *157*, 121-157.

Marr, D. C. (1982). Vision. San Francisco: Freeman.

Mayor, J., & Plunkett, K. (2010). A neurocomputational account of taxonomic responding and fast mapping in early word learning. Psychological Review.

Paradis, J. (2001). Beyond 'one system or two?': Degrees of separation between the languages of French-English bilingual children. In S. Dopke (Ed.), *Cross-linguistic structures in simultaneous bilingualism* (pp. 175–200). Amsterdam: Benjamins.

Perfors, A., Tenenbaum, J. B., Griffiths, T. L., & Xu, F. (2011). A tutorial introduction to Bayesian models of cognitive development. *Cognition*, *120*(3), 302-321. Elsevier B.V.

Quine, W. V. O. (1960). Word and object. Cambridge, MA: MIT Press.

Richardson, F. M., & Thomas, M. S. (2008). Critical periods and catastrophic interference effects in the development of self-organizing feature maps. Developmental science, 11 (3), 371-89.

Rosch, E., Mervis, C. B., Gray, W. D., Johnson, D. M., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology*, *8*, 382-439.

Roy, D. K., & Pentland, A. P. (2002). Learning words from sights and sounds : a computational model. *Cognitive Science*, *26*, 113-146.

Saffran, J. R., Aslin, R. N., & Newport, E. L. (1996). Statistical learning by 8-month-old infants. *Science*, *274*(5294), 1926-1928.

Seidenberg, M. S., & Mcclelland, J. L. (1989). A distributed, developmental model of word recognition and naming. *Psychological Review*, *96*(4), 523-568.

Siskind, J. M. (1996). A computational study of cross-situational techniques for learning word-to-meaning mappings. *Cognition*, *61*(1-2), 39-91.

Smith, L. B., & Yu, C. (2008). Infants rapidly learn word-referent mappings via cross-situational statistics. *Cognition*, *106*(3), 1558-68.
Swingley, D. (2009). Contributions of infant word learning to language development. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *364*(1536), 3617-32.
Vouloumanos, A. (2008). Fine-grained sensitivity to statistical information in adult word learning. *Cognition*, *107*(2), 729-42.
Wittgenstein, L. (1922). Tractatus logico-philosophicus. New York, NY: Routledge.
Xu, F., & Tenenbaum, J. B. (2007a). Word learning as Bayesian inference. *Psychological review*, *114*(2), 245-72.
Xu, F., & Tenenbaum, J. B. (2007b). Sensitivity to sampling in Bayesian word learning. *Developmental science*, *10*(3), 288-97.
Yu, C. (2008). A statistical associative account of vocabulary growth in early word learning. *Language Learning and Development*, *4*(1), 32-62.
Yu, C., & Smith, L. B. (2007). Rapid word learning under uncertainty via cross-situational statistics. *Psychological science*, *18*(5), 414-20.
Yurovsky, D., Fricker, D., Yu, C., & Smith, L. B. (2010). The active role of partial knowledge in cross-situational word learning. *Cognitive Science*.
Yurovsky, D., & Yu, C. (2008). Mutual exclusivity in cross-situational statistical learning. *Cognitive Science*.
Zhao, X., & Li, P. (2007). Bilingual lexical representation in a self-organizing neural network. Proceedings of the Twenty-Fifth Annual Conference of the Cognitive Science Society. Mahwah, NJ: Lawrence Erlbaum.
Zinszer, B. D., & Li, P. (2011). A SOM model of first language lexical attrition, 2787-2792.

Real-time State of Vigilance Detection for Probing Seizure Mechanisms and Seizure Control

Andrew M. Alexander, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Bruce J. Gluckman, Ph. D
Associate Director, Penn State Center for Neural Engineering
Associate Professor, Engineering Science and Mechanics, Bioengineering, Neurosurgery
The Pennsylvania State University

Abstract

States of consciousness in the brain offer a metric for explaining and predicting behaviors. There is a well-known correlation between epileptic seizure susceptibility and state of vigilance. Our goal is to design a system for detecting state of vigilance in real time using invasive electroencephalography and measurements of head movement. We will use this to probe the relationship between state of vigilance and seizure mechanisms. This system has potential clinical applications for state-based seizure prediction and control.

Introduction

For neuroscientists in a span of disciplines, brain states offer a useful measurement of human consciousness. In the fields of Brain-Computer Interfaces (BCI), Behavioral Neuroscience, or Computational Neuroscience, researchers consider analyses of discrete brain states crucial for ongoing studies about characteristics of waking and sleep states. Some studies suggest correlations between sleep states and neurophysiologic behaviors like epilepsy or sleep disorders such as sleep apnea[1]. Traditionally, sleep state has been determined by an expert analysis of biopotentials following a standardized method[2]. These biopotentials typically include electroencephalography (EEG) and electromyography (EMG) signals, but contemporary studies also consist of accelerometers to further and more accurately distinguish sleep state [3]. Researchers analyze raw data from biopotentials through sleep staging/scoring, which is a classification system for measuring sleep states.

Sleep scoring is done by hand and it often takes many hours to accurately score a data set. For applications that rely on this data, scoring by hand frequently causes potential delays when researchers need to score large quantities of information. To resolve this issue, post-processing techniques of automating sleep scoring have been developed, but this limits any applications to identification or classification, with no possibility for real-time clinical treatment options. In our research group, we seek to probe the relationship between state of vigilance and seizure susceptibility. Using the offline post-processing techniques, a lot of conclusions can be drawn about the seizure-sleep state relationship, but these conclusions are purely diagnostic. We seek to probe the relationship between rates of seizures and state of vigilance using perturbative stimulation. A real-time state of vigilance detector allows us to track state of vigilance as it changes dynamically over time, and allows us the ability to automatically stimulate based on a

threshold. By making that threshold a specific state of vigilance, we can explore the mechanisms of seizure generation and how they relate to the specific state of vigilance of interest. This system has applications in seizure control, as the perturbative stimulation can be introduced precisely at the onset of a seizure, disrupting it and preventing it from propagating through the brain.

Literature Review

Literature dating back to the 1960s suggests that sleep states have distinct characteristics that allow for a variety of automated detection methods [2], [4]. These states of vigilance have been chosen for this study with considerations of long term applications in the research group. These states are *NREM*, *REM*, and *Wake* (subclassified into $Wake_{\theta}$ and $Wake_{wb}$), and are characterized by different combinations of frequency and accelerometer channel data. In order to discern the incoming frequency of a signal, a power spectral analysis is done, which returns the value of the dominating frequency of a periodic signal[3], [5]. Due to the nature of the sleep scoring systems, a strict definition needs to be established for each of the frequency ranges, as they are not consistent between animal and human subjects, and can vary greatly between researchers in literature[6]. Recent studies in automatic sleep scoring systems use multiple definitions to account for the discrepancies between published work[3]. This allows for a more adaptable system where discrimination could be improved by using a different classification scheme. In general, the accepted standard spectral band limits of EEG are *Delta*, δ (0.5-4Hz); *Theta*, θ (4-8Hz); *Alpha*, α (8-13Hz); *Beta*, β (13-30Hz); and *Gamma*, γ (30-55Hz) [2], [7]. Each frequency band limit is closely related to a behavior or state of vigilance which, when coupled with EMG or accelerometer data, can be used to classify a state as a form of sleep or wake. The sleep states are characterized by immobile activity (low EMG or accelerometer) with oscillations <8Hz in EEG. *NREM* and *REM* can be differentiated by their EEG signature, since both are characterized by quiet accelerometer channels. *NREM* is characterized by oscillations in the δ(0.5-4Hz) band and *REM* is characterized by oscillations in the θ (4-8Hz) band in EEG signals. The wake states are characterized by accelerometer or EMG activity with higher frequency oscillations in EEG (>8Hz). $Wake_{\theta}$ is characterized by the same θ (4-8Hz) band as REM, but is able to be distinguished from REM by the quieter accelerometer/EMG channel data [7]. $Wake_{wb}$ is characterized by little to high accelerometer/EMG signal with a wide range of frequencies present in the signal, hence the name “wide band wake”.

Once the limits and definitions of these states are defined, a method of classifying data based on these spectral band limits is required. Manual scoring involves looking at windows of EEG and EMG/Accelerometer data and visually determining the sleep state. This is coupled with a power spectral density of the particular epoch to determine what the dominating frequency of biopotentials was during that specific epoch (small time window, usually 10-15 seconds). To make a determination of state, a “scorer” looks at the incoming data, decides whether it is a sleep or wake state, and then looks at the incoming frequency to determine which bin it fits under. For example, if the signal coming in had high accelerometer movement and showed a peak in the signal in the 4-8Hz range, it could be determined that the animal was in $Wake_{\theta}$ or “active wake”. Automated techniques of sleep scoring follow this theory of operation, but require discrete operations and data transformations in order to be able to classify sleep. Linear discriminant analysis (LDA) has proven useful for this as well as a variety of related tasks [8],

[9]. LDA takes a multi-dimensional, multi-variate system and breaks down the components to provide maximum separation between each of the variables while reducing the dimensionality. More simply, it looks for a specified number of characteristics (4 in our case – one for each state of vigilance), and separates them into groups. We feed the classifier all of the EEG and accelerometer information to build the classifier's "picture" of each of the four sleep states. This has proven useful for a variety of clinical and diagnostic applications, where discrimination of key states is crucial [10], [11].

Classifying sleep states has proven useful for a variety of disorders, particularly epilepsy. It has been suggested that sleep and state of vigilance have effects on rates of seizures in patients with epilepsy, and the need to explore that relationship further has necessitated a method of real-time state determination.

Methods

Data Collection

EEG, accelerometer, and video recordings of rats were continuously monitored using custom-made acquisition hardware and software written in LabView (Labview, National Instruments). A head-mounted preamplifier connects depth electrodes and cortical surface electrodes for EEG, located in the dorsal hippocampus and on Bregma-referenced coordinates, respectively [12]. The preamplifier also contains a biaxial MEMS accelerometer that detects motion in three dimensions. The EEG and acceleration signals are sampled at 2kHz and stored as word type (16-bit signed integer) binary data files in one-hour long continuous segments. The animals are located in isolation with a 12-hour light-dark cycle. Cameras with infrared capabilities allow monitoring during all hours to be used for better verification of state of vigilance.

Manual Expert Sleep Scoring

EEG and acceleration channels are scored visually by an expert (MSS) to label sleep state as *REM*, *NREM*, $Wake_{\theta}$(Active Wake), or $Wake_{wb}$(Quiet Wake). Epochs (small windows of data) of 10-15 seconds are chosen to match literature on sleep state scoring [7]. This epoch window aims to provide a long enough window to discern sleep state while being short enough to only contain one state.

To score sleep, each of the 10 second epoch windows is analyzed to determine the state in that window as sleep or wake. Subsequent analysis aims to further discern sleep as *REM* or *NREM*. If there is a transition to a different state or the animal had a state lasting less than 10s, that transition period is considered indeterminate and is not scored. To score sleep as one of the sleep states, EEG signals must be <8Hz and the accelerometer channels should be quiet, with little to no activity. *REM* is characterized by the θ frequency band, and NREM is characterized by the δ frequency band.The remaining two wake states are classified as *Quiet Wake* if EEG oscillations are in the $\alpha, \beta, or\ \gamma$ bands (all above 8-10Hz) with high accelerometer signals, and $Wake_{\theta}$ if the EEG oscillations are in the θ frequency band with some to high accelerometer signals.

Automated Post-Processing Scoring

To score data automatically, a classifier built on Fisher's linear discriminant analysis (LDA) is created. This classifier, when applied to raw EEG signals, separates the signals into groups based on what feature sets are desired. Using Matlab (Mathworks Ltd.), spectral power is computed for specific EEG channels and accelerometer channels that are chosen based on how noisy the signal is. The ideal signal is a clean one, with little to no background noise. To obtain spectral power we must first take non-overlapping 1s windows and convolve them using a Hamming window. A power spectral density (PSD) is computed for the resulting convolution and then averaged into 0.5Hz bins. This gives us the power of a wide array of incoming frequencies in 0.5Hz resolution. The results of the PSD are averaged for each 10s epoch window. In each of these windows, the power of each of the specific bands (θ, δ, etc.) was summed, and the results are used as input variables (known as features) for classification using LDA. In calculations, the $\log(x)$ of the power was taken to provide a more dynamic response, where a tolerance of $\log(x + \epsilon)$ was included to ensure that a logarithm of zero was avoided.

Pipeline Processing

Using the same theory of application as an offline sleep scorer, a real-time system is proposed that would be able to perform the same sleep state scoring in real-time. This pipeline process handles data continuously, and analysis can be done on incoming data in real time by using slightly different approaches to calculate feature sets. Once these feature sets are obtained, they can be compared against the manually scored data. By matching the spectral signatures of the working feature set to one of the states defined by the manually scored data, a decision can be made in real time to discern sleep/wake state.

In any signal processing, the spectral power can only be calculated in bins due to the nature of the power spectral density calculations. In offline analysis, this was accomplished by dividing the 60 minute file into 1s non-overlapping windows and convolved. The bins for our pipeline processing are accumulated over similar 10s epochs as the offline analysis, only instead of dividing 60 minutes of data, the program need only store the last 10 seconds of data that had been collected to perform its averaging. Since a convolution of data of this nature can be reduced to simple addition, the pipeline process needs only a working memory of summations of each of these spectral powers to generate a feature set. The streaming data from the pipeline can be filtered by applying the classifier built by LDA in offline analysis to it. This will essentially act as a preliminary filter for each of the frequency bins to give us a good “first guess” of the state of vigilance. The classifier built in offline analysis set up boundaries for feature discrimination that the pipeline feature can be compared against. By matching the spectral signatures of the classifier and the pipeline feature, the pipeline feature can be classified. Since this feature set is built from the past 10 seconds worth of data, it theoretically takes no more than 10 seconds to begin accurately scoring sleep with this pipeline system.

Using the features built in real-time, a determination of state can be made. Once this state is known, any number of actions can be done. For our purposes, we aim to implement a perturbative stimulation system that interrupts a certain sleep state, namely *REM.* The system

designed will be able to detect *REM*, deliver controlled stimulation, and then continue to collect data for subsequent analysis as to the mechanics of the seizure generation and how it pertains to state of vigilance. Ideally, this would allow for not only an improved model of seizure generation, but also allow for state-based seizure control.

Preliminary Findings

A custom piece of software exists in our lab that generates features from previously recorded offline data files. These features are simply manipulations of the power spectral density of the signal and include numerical operations such as mean square, derivatives, and averages. These features are used an inputs into the MATLAB script that I have written to make a determination of state. This is akin to the offline methods we currently use, the difference being that this script takes into account the transition to pipeline processing and includes simple Boolean logic and structures that can be implemented into LabVIEW for the real-time state discrimination.

At this stage in the development process, the input variables are limited to accelerometer data. This is to simplify as well as guide the design of the program – accelerometer data is very easy to interpret by eye when looking at the raw data. A such, thresholds for state boundaries can be set accurately and adjusted with ease on accelerometer channels by looking at the data stream. Later, when hippocampal EEG is considered, the refinement to the accelerometer channels' discrimination variables will make it easier to fine tune the thresholds and boundaries for discriminating EEG.

Using the analysis paradigm I created, I was able to compare the program's efficacy of determining sleep or wake using just accelerometer data. Using accelerometer data alone renders it impossible to discern any state other than simple *sleep* or *wake*, because any further determination (REM, NREM, active wake) relies on frequency analysis of hippocampal EEG. Since manually scored data does discriminate between the sub-categories of *sleep* and *wake*, I had to lump the sleep and wake states together in order to provide a basis for comparison of my classifier. When compared to manually scored data, this analysis on accelerometer data alone considering just *Wake*versus *Sleep* shows an agreement percentage of 74 ± 5%. When coupled with the EEG data, it is anticipated that the agreement percentage will go up, as well as allow me to compare the efficacy of my classifier to discern the sub-categories of *Sleep* and *Wake*. Ideally, a rate of agreement between 79-87%is desired. Even between two or three experts manually scoring data, discrepancies exist because of the relatively subjective nature of manual sleep scoring. Typical values of user-user agreement are in the 83 ± 4% range for most states of vigilance, which is why a target agreement of the classifier is set at that range – the algorithm should at least be as effective as the system it is replacing.

I have written a piece of LabVIEW software that takes in raw data and computes a power spectral density on it in real time. From that power spectral density taken over a period of 10 seconds, features can be generated and subsequent analysis can be done on it. Using the logic implemented in my MATLAB script, a LabVIEW equivalent is being further developed to incorporate all of the parts that I have built into the final real-time state of vigilance detector.

Discussion

Scoring state of vigilance has been an important part of many research topics in a wide range of disciplines. Post-processing techniques offer a way to classify and explain behaviors but offer little flexibility in terms of feedback mechanisms. Analysis in post-processing is able to discern states, but offers virtually no way to provide feedback to the subject being recorded from. Real-time systems offer a method of disrupting a state at specific times. Because of this conditionality, systems can be designed to trigger different kinds of interference at different times. For our lab, we have found that there is a strong correlation between REM and seizures. Because of this relationship, we aim to design a system that responds to REM and disrupts it by providing a controlled stimulation at the onset of a REM bout to both test our hypothesis as well as test treatment methods. The decision to stimulate and the actual stimulation must be done in matters of milliseconds, so having a reliable real-time detection system is essential for this goal.

In designing the SOV detector, many considerations were made about what logic and features to use and whether or not they would be effective in the pipeline/real-time process. Since the first step was to generate a real-time power spectral analyzer using sound, it made sense to make determinations based on a specific frequency band and the time spent within that frequency band. When transitioning to the EEG and accelerometer data, this method of feature generation proved useful for accelerometer data but not EEG data. This is because there are a lot of other factors to consider when dealing with sleep states in hippocampal EEG. The transition from one rhythm to another is not a discrete jump – the signals slowly shift up or down the frequency spectrum both within a state as well as during a transition. These transition periods cause a lot of over-classification in the algorithms. Basically, if there are more signatures in the data than we are looking for, the algorithm will generalize these transitions and other erratic behaviors as one of the sleep states (REM, NREM, etc.). This decreases accuracy because transitions between states in the real-time signal could now be classified as something that they are not. To remedy this, an algorithm based around the LDA classification technique is being further developed to run in real-time. Time was a limiting factor in the implementation of this classification scheme during this project, but will be implemented in further work. This classifier will describe the features numerically, providing a filter for incoming data to be separated and classified into a specific group. This classifier relies on post-processing methods to be generated, but can be implemented in a real-time system once it is available. It is important to note that this classifier would need to be generated and trained for each test subject it is being applied to. No two brains are exactly alike, so no classifier is general enough to work for all subjects without some modification.

A major focus of this project was not only to obtain a working real-time state of vigilance detector, but also to improve the communication between the computer interface and the acquisition hardware to provide more reliable and accurate measurements. In our lab, data acquisition is the heart of all ongoing research, whether it is for designing the electrodes or performing analysis on data. As such, it is imperative that all recordings taken from animals are as accurate and reliable as possible. In order to make real-time measurements better, improvements to the fine details of operation of the acquisition hardware had to be made. These changes were made to both the firmware of the acquisition hardware as well as the software interface running on our computer acquisition systems. The robustness of this system is crucial for being able to transition to a system that is able to provide controlled stimulation at a

moment's notice. By improving the methods of interfacing with all aspects of the hardware, we can ensure that our decisions and analyses are as accurate and precise as possible moving forward, and that we can indeed add our desired functionality to our system.

References

[1] C. W. Bazil and T. S. Walczak, "Effects of sleep and sleep stage on epileptic and nonepileptic seizures.," *Epilepsia*, vol. 38, no. 1, pp. 56–62, Jan. 1997.

[2] A. Rechtschaffen and A. Kales, "A manual of standardized terminology, techniques and scoring system for sleep stages of human subjects," 1968.

[3] S. Sunderam, N. Chernyy, and N. Peixoto, "Improved sleep-wake and behavior discrimination using MEMS accelerometers," *Journal of neuroscience …*, vol. 163, no. 2, pp. 373–383, 2007.

[4] R. J. Broughton, "Polysomnography: principles and applications in sleep and arousal disorders," *Niedermeyer E. Electroencephalography: basic principles, clinical applications and related fields*, vol. 4, pp. 858–895, 1987.

[5] B. a Gross, C. M. Walsh, A. a Turakhia, V. Booth, G. a Mashour, and G. R. Poe, "Open-source logic-based automated sleep scoring software using electrophysiological recordings in rats.," *Journal of neuroscience methods*, vol. 184, no. 1, pp. 10–8, Oct. 2009.

[6] W. Witting, D. van der Werf, and M. Mirmiran, "An on-line automated sleep-wake classification system for laboratory animals," *Journal of Neuroscience Methods*, vol. 66, no. 2, pp. 109–112, Jun. 1996.

[7] C. Robert, C. Guilpin, and a Limoge, "Automated sleep staging systems in rats.," *Journal of neuroscience methods*, vol. 88, no. 2, pp. 111–22, May 1999.

[8] B. Flury, *A first course in multivariate statistics*. Springer, 1997.

[9] C. Bishop, *Pattern recognition and machine learning*. Springer New York, 2006.

[10] H. Hamrahi, B. Chan, R. L. Horner, and L. Richard, "On-line detection of sleep-wake states and application to produce intermittent hypoxia only in sleep in rats On-line detection of sleep-wake states and application to produce intermittent hypoxia only in sleep in rats," pp. 2130–2140, 2013.

[11] D. De Massari, C. A. Ruf, A. Furdea, S. Halder, T. Matuz, and N. Birbaumer, "Towards Communication in the Completely Locked-In State: Neuroelectric Semantic Conditioning BCI," *Brain-Computer Interface Research*, pp. 111–118, 2013.

[12] G. Paxinos and C. Watson, *The Rat Brain in Stereotaxic Coordinates*. .

Functional Changes Related to Episodic Memory in People with Traumatic Brain Injury

Jason A. Blake, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Frank Hillary, Ph.D
Associate Professor of Psychology
College of Liberal Arts
The Pennsylvania State University

Abstract

Traumatic brain injury (TBI) has been shown to have a significant effect on every type of memory. Recently, Neuroscience literature on TBI deficits, and its behavioral effects, has increased. However, much of the research neglects considerations about the functional changes that occur after serious brain injuries. In relation to memory, specifically episodic memory, this study will analyze how those with a TBI handle for memory deficits, and identify what structures and systems are used. The current findings revealed an increase in the functional use of both hemispheres of the parietal lobe, the cerebellum, and the posterior parietal cortex in TBI participants. Continued work to clarify how the brain adapts to injury may positively influence the quality of neuro-rehabilitation services and drug therapies.

Introduction

Episodic memory enables human beings to remember specific moments in their lives in a way that is still being understood. Episodic memory is a type of long-term memory of events and is also the process of accessing those moments when the recall is necessary or triggered by association [1]. One important consequence of Traumatic Brain Injury (TBI) is a disruption in encoding and recognition of episodic memory [2, 3]. According to the Center for Disease Control (CDC), approximately 1.7 million people annually suffer from a TBI. In most cases, a patient cannot regain full memory function after his or her injury. Additionally, there are other consequences for those with an injury that negatively influences their employment and relationships. Those with moderate to severe injuries typically lose relationships and jobs due to behavioral and cognitive changes. Unfortunately, in contrast with working, semantic, or remote memory, few studies investigate the relationship between injury and episodic memory. There has been a significant change observed in cerebral mechanisms involved during episodic and other forms of memory in TBI subjects when compared to healthy controls. [4, 5]. The goal of this study is to research the question of how the brain adapts its networks after a TBI specifically in relation to the brain functions used in episodic memory that are not used in healthy controls. In order to improve rehabilitation, doctors and researchers need to better understand the brain systems and structures behind the mechanisms affected in episodic memory.

Brain Injury

TBI is damage sustained to the brain due to an external force impacting the head. It is classified as something that is acquired and is not progressive. Cognitive and physical impairment depends on the severity of the injury and the length of time unconscious after injury [6]. Quality and speed of recovery is dependent on age of injury. An injury to a prefrontal network is handled differently in terms of plasticity when you compare a developing network to an adult's established prefrontal system [7]. Coronado et al. mentions how prevalent this problem already is and that researchers may not even know how common this problem is because many of these cases do not lead to hospitalization. The injuries then go unreported so researchers may not even know how common this problem is. They mention gaps in TBI epidemiology as well as important steps that have been taken to decrease the incidence and suffering of TBI patients. This means TBI and TBI related problems will continue to be a major issue as the number of severe injuries continues to rise.

The severity of any brain injury is defined on a scale called the Glasgow Coma Scale (GSC). After analyzing a patient based on a number of criteria, he or she is usually placed into one of three levels of severity: mild, moderate, severe. Mild TBI typically has a GSC score between 13 and 15 at time of hospital admission. Moderate TBI patients score between 9 and 12 while severe patients score below 8 [6]. This score is intended to guide doctors towards the proper treatment but there has been controversy over misdiagnosed assessments and relying solely on this assessment [8-11]. Some common problems related to severe TBI include: increased aggression[12], decreased social skills as well as increased social anxiety, decreased educational performance and problem solving skills [13]. One of the most debilitating aspects for many TBI patients revolves around their tremendous memory issues, whether it is recalling old memories or forming new ones [14, 15]. It is important to understand the GSC when dealing with recovery from the injury and understanding the severity of the disability.

Episodic Memory

The current research will examine episodic memory deficit in moderate to severe TBI using functional MRI. Episodic memory can be divided into separable processes: encoding, retrieval, and consolidation as these different processes seem to involve different neuronal structures [1, 16-18]. The processes that will be assessed here are encoding and recognition. Recognition is a type of memory retrieval based on distinguishing previously encountered stimuli from stimuli that is new. Encoding is that actual action of memory formation into a construct that can be recalled later. Episodic memory as a whole relies heavily on the medial temporal lobe (MTL) system where the hippocampus is located and has been found to incorporate bilateral prefrontal areas for encoding and retrieval [1, 19]. When the brain is damaged it uses other areas to compensate for an injury. However, the work done focusing on the brain adapting to these other areas has mostly been done in relation to working memory and not nearly as much with episodic memory. Even with the growing literature in working memory, interpretations still vary on what is actually going on [20-22]. What remains to be determined is what is activated in the brain of control patients during an episodic memory task compared to that of TBI patients who are participating in the same task.

There is growing literature combining fMRI and behavioral methods for observing functional changes related to memory and other known TBI complications. FMRI is the most popular method of imaging used by research to infer and understand neurological changes [1].

However, only a few researchers have used fMRI to discuss where activation happens while the brain is using its episodic memory. One study in particular using fMRI in relation to episodic memory was conducted by Rugg et al (2002). The memory was tested with a simple yes or no recognition task and activation was observed in an fMRI scanner. This study distinguished some important processes that have not normally been seen as "different". For instance, when talking about episodic retrieval, or recollection, it is useful to distinguish between the processes that work off of retrieval cues while recovering information from memory, called the pre-retrieval processes. Those processes that are used during a retrieval attempt are called post-retrieval processes. This is noteworthy because researchers have understood that a many of the systems and structures that originally have been grouped together as the same really do have some important and different functions. These researchers found an overlap with activation in the left ventral prefrontal cortex and left anterior hippocampal formation for subsequent memory tasks.

The implications described by Rugg et al. suggest these findings offer no support for the idea that the neurology supporting episodic encoding is task sensitive, whether the task is an alphabetical task or one regarding animacy (is the word a living or nonliving entity). The researchers mention that in other studies the regions that consistently show more activity for old items than for new items suggests great significance for episodic over other memory forms. These areas are the left anterior prefrontal cortex and the lateral and medial parietal cortex. Findings from two other fMRI experiments suggest that these areas are important for recollection. This is different than 'Known' items as authors found that items judged as remembered over 'known' garnered greater hippocampal activation [23]. One issue that Rugg et al discovered is the need to develop methods to bring electrophysiological data (EEG) and haemodynamic data (neuronal blood flow aka fMRI data) together so that researchers can get good spatial as well as good temporal resolution under the same conditions and then use that measure to identify how different regions respond to memory tasks. Such a technique has been developed in recent years called EEG-fMRI or EEG-correlated fMRI where EEG and fMRI data are recorded simultaneously [24].

One of the stages involved in episodic memory is the "retrieval" of information. Rugg et al. suggested the model of memory as a "dual process" [18] in which one retrieval cue, for instance a vocabulary test item or a memory test word, will elicit two kinds of feedback. The first bit of feedback is a 'recollection signal' that provides detail information and context related to the cue and the other being a 'familiarity signal' that gives past experience with the number of times it has been encountered before. Knowing that the signal is split allows researchers to experiment in a way that separates these processes to see and understand everything that is happening on its own. The evidence so far has shown that this separation occurs in the medial temporal lobe (MTL) as well as just at the level of the outer frontal cerebral cortex. The MTL includes: the hippocampus, perirhinal cortex (BA 35 and 36), entorhinal and parahippocampal cortices. FMRI scans show that successful recollection is associated with activity in the hippocampus and parahippocampal cortex, however this has not been shown in all participants. In another study recall was associated by enhanced connectivity between the hippocampus and the perirhinal cortex as well, along with the parahippocampal cortex. The connectivity analysis also showed that the perirhinal cortex modulated the hippocampus during recognition but was then modulated itself by the hippocampus during recall [25]. These findings were different in two recent studies where items recognized as recollection elicited a greater hippocampal and parahippocampal activity than items matched for memory strength but stated to be "strongly familiar" [26, 27]. In summary what has been consistently associated with recollection-sensitive

fMRI effects are the following: the hippocampus, parahippocampal, posterior cingulate and lateral parietal cortices.

Imaging

One method gaining increased application in the study of cognitive deficits after TBI is functional magnetic resonance imaging (fMRI). FMRI will become incredibly relevant as each brain area that is activated will be looked at during certain episodic memory tasks and compared to non-TBI brains under the same task. An fMRI brain scanner can determine the level of and changes in blood flow in the brain. It uses what's called the blood-oxygen-level-dependent (BOLD) contrast to match structure and function. This imaging technique relies on the assumption that there is a direct relation between cerebral blood flow and neuronal activity [28]. There is little in the literature about how the brain reorganizes in relation to episodic memory even though every day millions of people struggle to remember simple things about what went on during their day. By focusing on changes seen in healthy brains vs TBI brains, it may be possible to improve rehabilitation techniques for post-injury patients.

It is important when relying on fMRI data and the research that has come from it to point out the arguments some have against how many researchers interpret what they're seeing. Cole et al. argue that there are too many issues, methodologically and interpretively, for researchers to fully understand the vastly complicated structures and systems that many of them claim to understand [21]. The researchers also note that while they have been very successful at separating the neuronal signals from other noise like cardiovascular signals using algorithms called ICA (independent Component Analysis); they have not been able to distinguish psychological noise from real neuronal components. Attempts to create an algorithm for this leads to many misclassifications by removing important evidence. The balance needs to be met between insuring the information being received is accurate and insuring that it does not contain too much extra noise.

In fMRI the unit of measurement used is called a *voxel* and can contain millions of neurons. The activities of these neurons are measured indirectly by their impact on the blood flow of the brain. To deal with the information from all these signals activity maps are created and each voxel is analyzed separate from the others to determine brain "activation" [22]. Some researchers see a problem in this, for this system only maps a large localized response where each voxel is compared to the stimulus, instead of relating it to other voxels in the brain. They state that a huge hurdle of systems neuroscience is to understand the parallel interactions at a deeper level in order to understand brain communication via connectivity of neurons [22].

Methods and Materials

To collect the functional data a new high-field (3T) head-dedicated scanner was used. This Siemens Allegra MR scanner is a state-of-the-art, head-dedicated, high-field (3T) MR scanner that is optimized for fMRI. It uses a pulse sequence-programming environment that provides full access to operating parameters via a C-like language. This instrument is sited at UMDNJ-New Jersey Medical School and is fully dedicated to research. Functional MRI data acquisition, pre-processing, analysis and visualization will be based on well-characterized methods that have been reported in the published literature and used extensively in our own research.

All data analysis is currently performed using the SPM8 for fMRI processing and SPSS for behavioral data analysis. The paradigms allowed us to collect both behavioral (i.e., response

accuracy and response latency) and fMRI (global and regional cerebral activation) data. Functional MRI data (i.e., change in hemodynamic response associated with cerebral activation) will be analyzed using the random effects procedure. This procedure is used to identify neuroanatomical regions of significant activation in each group, and to identify regions that are significantly more activated in one group versus the other. All raw scan data will undergo spatial realignment using the SPM8 six-parameter model to remove minor (subvoxel) motion-related signal change.

The data that will be analyzed was collected from 12 TBI participants and 8 non-TBI controls. The TBI patients range in severity from a 3 to a 13 on the GCS. The average age for these participants is 40 years old with a range of 21 to 58. The average number of months these participants have had their TBI before being scanned is just over 7 and a half years. The most common cause of TBI for these individuals is motor vehicle accidents (MVA). The average age for the healthy controls is just over 37. All subjects completed a consent form approved by an institutional review board at initiation of the testing session. This data was able to be analyzed using the SPM program.

The design for one run of the episodic memory task will yield fMRI scanning time of approximately 4.3 minutes (i.e., 256 seconds). There will be a total of four runs (see Table below) for a total scanning time of approximately 17 minutes (i.e., 1024 seconds).

Run	Condition	
1	Experimental	High Executive Control Word and Picture Encoding Task
2	Recognition	Recognition of High Executive Control Encoding Task
3	Experimental	Low Executive Control Word and Picture Encoding Task
4	Recognition	Recognition of Low Executive Control Encoding Task

High Executive Control Condition: Four categories of pictures and words, with four in each category were presented. Subjects were instructed to try and learn all the items. Subjects were then asked to judge whether each word/picture presented had pleasant or unpleasant associations and to press the corresponding button on a key pad placed under their right hand.
Low Executive Control Condition: Four categories of pictures and words, with four in each category were presented. Subjects during these runs were informed what the categories would be. They were further informed that all the words/pictures from one category will be presented together. Subjects were instructed to try and learn all the items and informed that keeping the list structure in mind would be helpful. Subjects were again asked to judge whether each word/picture presented had pleasant or unpleasant associations and to press the corresponding button on a key pad placed under their right hand.
Control Task: The control task for both the word high and low encoding conditions consisted of presentations of the letter “X”.

For all of these conditions participants were asked to press the response button once each time the letter “X” appears. This condition controled for cerebral activations associated with seeing letters, subvocalizations, and making a simple button-press response.

Encoding

Prior to each stimulus presentation, a cross-hair fixation target was presented for 500 msec in order to prompt the participant to attend to the visual display. A stimulus (i.e., a word or picture) was then presented for 2 seconds, followed by a 2-second interstimulus interval (ISI). Participants were required to press the response button during the ISI if they have a "pleasant" association to the word. Cerebral activations were recorded in an event-related manner, with a total of 8 new words being presented during each 32 sec block of time (total of 16 words presented to each participant).

Recognition

Prior to each stimulus presentation, a cross-hair fixation target was presented for 500 msec in order to prompt the participant to attend to the visual display. A stimulus (i.e., a word or picture) was then presented for 2 seconds, followed by a 2-second interstimulus interval (ISI). Participants were required to press the left response button during the ISI if they recalled the word/picture as having been previously presented during the encoding task and the right response button if the word/picture was not presented during the encoding task. Of the 16 words/pictures from the original list, each participant was presented with 8 words/pictures of the target items from the original 16 interspersed with 8 novel words/pictures that will serve as foils. This is done in order to keep the recall session at the same length as encoding. Cerebral activations will be recorded in an event-related manner, with a total of 8 words/pictures being presented during each 32 second block of time (total of 16 words and 16 pictures presented to each participant).

Stimuli

WORDS

HIGH ENCODING CATEGORIES	LOW ENCODING CATEGORIES
VEGETABLES	INSECTS
SHAPES	COLORS
SPICES	MEAT
BABY ITEMS	APPLIANCES

PICTURES

HIGH ENCODING CATEGORIES	LOW ENCODING CATEGORIES
SPORTS	TOOLS
MUSICAL INSTRUMENTS	CLOTHING
ANIMALS	FRUIT
TRANSPORTATION	FURNITURE

Sample Design of Experimental Run

32 sec		*32 sec*		*32 sec*		*32 sec*	
Experimental Task (8 stimuli)	Control Task	Experimental Task (8 stimuli)	Control Task	Experimental Task (8 stimuli)	Control Task	Experimental Task (8 stimuli)	Control Task
32sec		*32sec*		*32sec*		*32sec*	

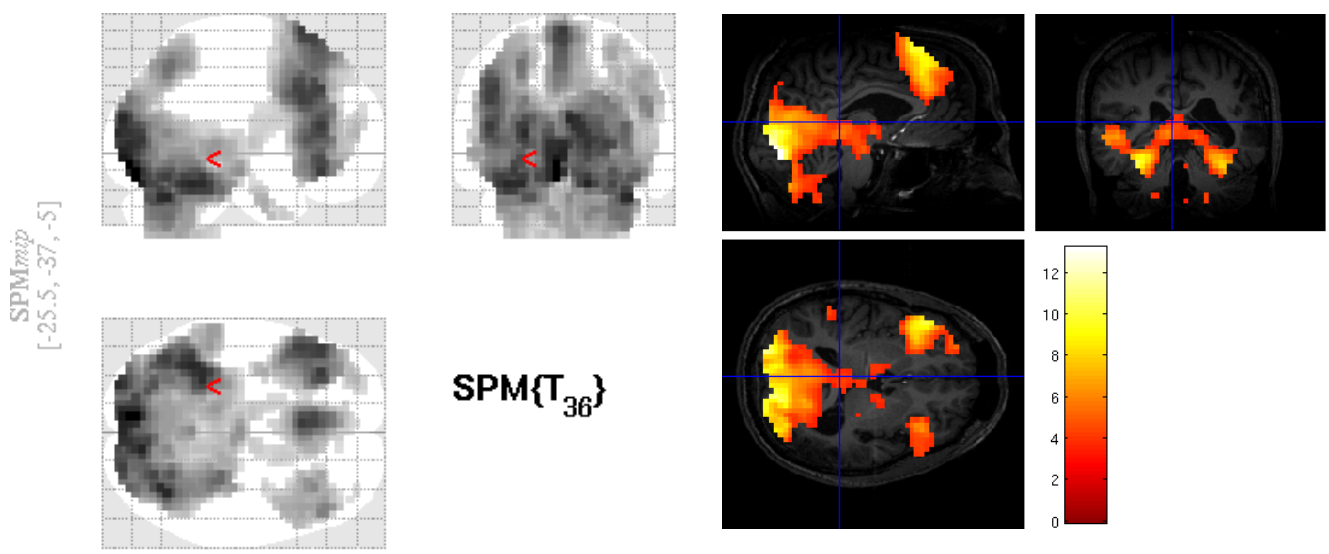
Results

The scans that were used at the time of writing this were of 12 TBI patients and 8 healthy controls (HC).We focused on the scans of the encoding step of the episodic memory process. The shared activation of the HC and TBI patients is consistent with the current episodic memory literature as well as the HC scans. This is activation in the visual cortex, medial temporal lobe, outer frontal cortex, and motor cortex. The scans of TBI patients showed significant activation in both hemispheres of the parietal lobe, the cerebellum, the posterior parietal cortex and the sub parietal sulcus as well as an increase in activation in the motor cortex, the somatosensory cortex and the lingual gyrus when compared to healthy controls.

<u>Areas used by both groups</u>:

Statistics: *p-values adjusted for search volume*

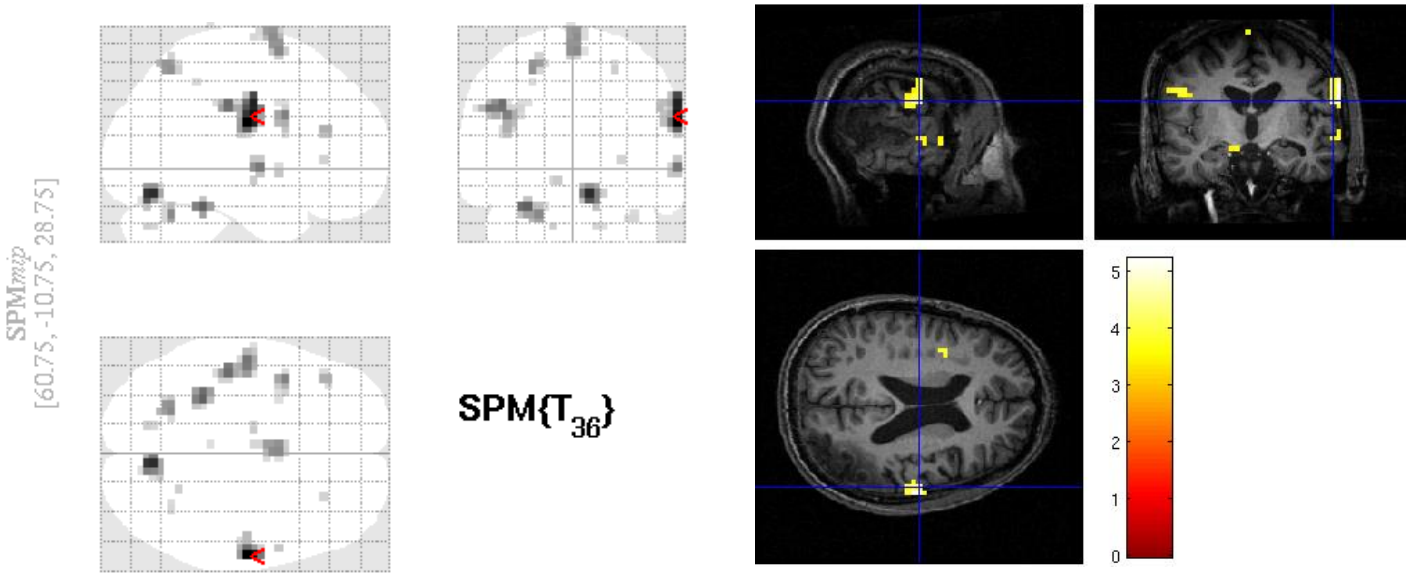
set-level		cluster-level				peak-level					mm mm mm		
p	c					$p_{FWE-corr}$	$q_{FDR-corr}$	T	$(Z_{\equiv})$	p_{uncorr}			
		0.000	**0.000**	**1483**	**0.000**	**0.000**	**0.000**	**10.41**	**7.03**	**0.000**	**-3**	**19**	**70**
						0.000	0.000	10.34	7.00	0.000	-48	30	14
						0.000	0.000	10.28	6.98	0.000	-33	30	-12
						0.000	0.000	10.15	6.93	0.000	-48	19	32
						0.000	0.000	10.08	6.90	0.000	-44	30	36
						0.000	0.000	10.05	6.89	0.000	-48	27	32
						0.000	0.000	9.30	6.60	0.000	-44	23	6
						0.000	0.000	7.73	5.90	0.000	-44	23	-9
						0.033	0.013	5.34	4.56	0.000	-29	23	59
						0.046	0.018	5.22	4.47	0.000	-29	53	10



TBI patients:

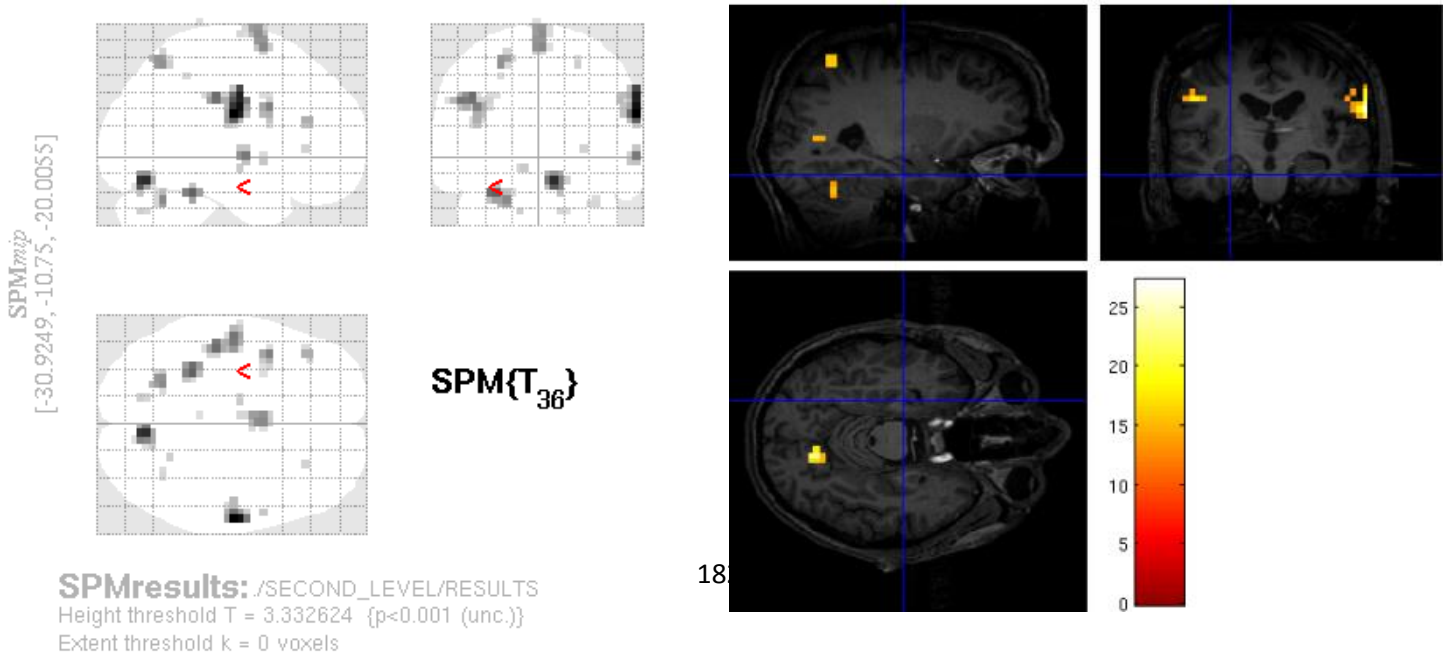
Statistics: *p-values adjusted for search volume*

set-level		cluster-level				peak-level					mm mm mm
p	c					$p_{FWE\text{-}corr}$	$q_{FDR\text{-}corr}$	T	$(Z_{\equiv})$	p_{uncorr}	
		0.104	**0.413**	**40**	**0.031**	**0.046**	**0.307**	**5.22**	**4.47**	**0.000**	**61 -14 25**
						0.098	0.307	4.90	4.26	0.000	61 -11 36
						0.852	0.958	3.64	3.33	0.000	50 -14 32



Statistics: *p-values adjusted for search volume*

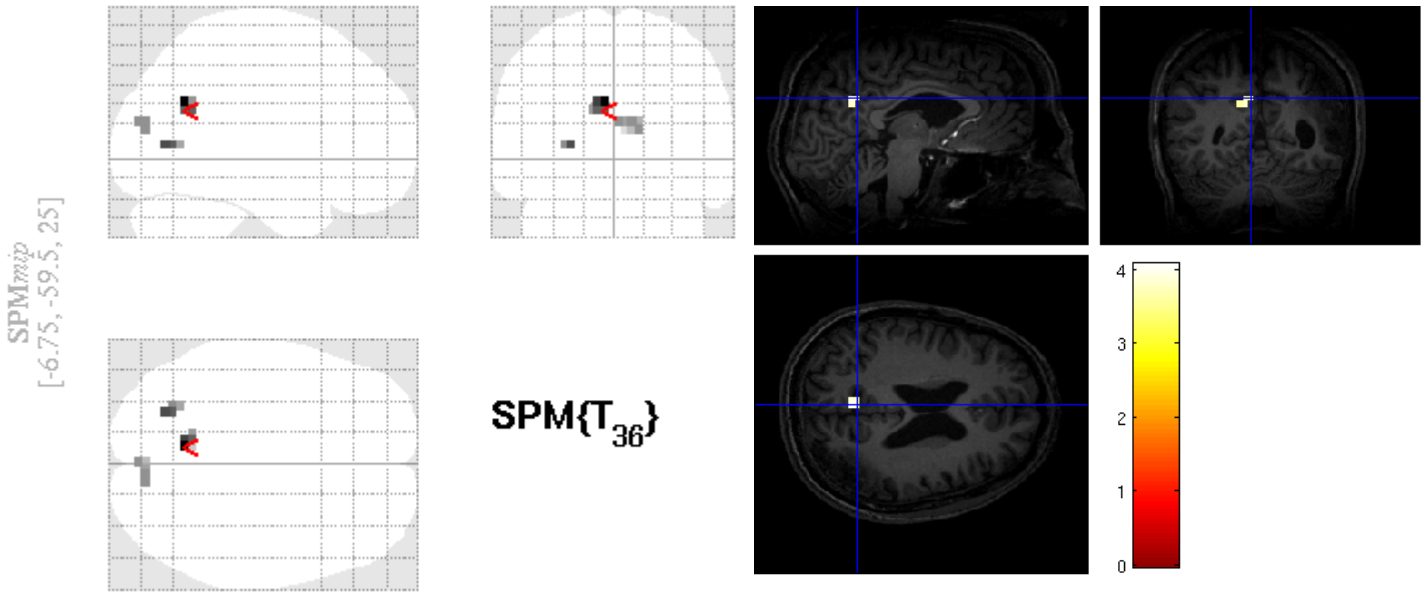
set-level		cluster-level				peak-level					mm mm mm
p	c					$p_{FWE\text{-}corr}$	$q_{FDR\text{-}corr}$	T	$(Z_{\equiv})$	p_{uncorr}	
		0.888	**0.742**	**2**	**0.625**	**0.908**	**0.958**	**3.53**	**3.25**	**0.001**	**-10 -11 -9**



Healthy participants:

Statistics: *p-values adjusted for search volume*

set-level		cluster-level				peak-level					mm mm mm
p	c					$p_{FWE-corr}$	$q_{FDR-corr}$	T	$(Z_{\equiv})$	p_{uncorr}	
		0.658	0.459	8	0.306	0.525	0.606	4.07	3.67	0.000	−7 −60 29



Discussion

The goal of this study is to examine episodic memory functioning after TBI using functional imaging. The primary finding was that in cases of TBI there is increased involvement, or "recruitment" of additional brain regions. Some of these results were consistent with the current literature while others were not.

Primary findings of episodic memory task, healthy controls and TBI:

These results show activation in the occipital lobe, the primary motor cortex, the medial temporal cortex (MTL), and the frontal lobe. These areas are consistent with the current neuroanatomical research relating to episodic memory encoding [4, 5]. These findings provide the basis for comparing the samples using this standard episodic memory task.

Activation of TBI greater than healthy controls:

The fMRI scans showed an increase in BOLD activation of TBI brains over healthy controls in the lingual gyrus, the precentral gyrus, and both hemispheres of the parietal lobe, the cerebellum, the somatosensory cortex and the motor cortex. These findings may reflect a change in strategy of encoding for TBI participants. Such an increase in the parietal lobe as well as other areas suggests an increase in "cerebral challenge" or demand. TBI participants must exert more energy and cognitive effort to complete the same task as healthy controls, as suggested by Ricker et al [4]. An increase was shown in the cerebellum during encoding for these participants, which is not concurrent with other research done in this area [5]. The cerebellum has been shown to have a role in memory possibly for the purposes of offsetting an increase in memory load [33]. The collected data shows that TBI patients use this area in an increased capacity which suggests

an adoption of different strategies used in the brain once a particular system is damaged or inactive in some way. This adoption of strategies is likely consistent and common in the TBI patients. This could be explained as an attempt for the brain to recruit areas local to the injury in a way to decrease memory load in other particular areas.

The increase in BOLD activation of the visual, motor, and somatosensory cortex could reflect a delay in reaction time by those with TBI. These participants had a longer reaction time and very likely spent more time looking at the stimuli as well as thinking about pressing the correct buttons.

Activation in healthy controls greater than TBI:

There is only one area that is active in HCs over TBI participants. This area appears to be the cuneus or the precuneus. The cuneus is a wedge shaped portion of the occipital lobe involved in basic visual processing. It is unclear why the HCs would be using this area while the TBI patients did not other than damage to that area. If it is the precuneus then it is hard to determine why it is used in healthy controls and not TBI patients since it has not received much attention in research due its location in the brain. It has been described as "one of the less accurately mapped areas of the whole cortical surface" due to its lack of study [29]. It has been speculated to have many roles linking to semantic processing but has been found to have some link to episodic memory [30-32]. Rarely the precuneus is attributed to motor vehicle accidents, the most common form of TBI, but it has been linked to gunshot wounds and acquired brain injuries such as strokes. It is not clear why this effect is being observed but it is possible that the HCs are engaging in greater semantic processing of the stimuli that is to be recalled.

Limitations

There are several constraints that were experienced during this research. One constraint was the sample size of my healthy controls which limited my analytical power. This can also impact reproducibility. Future work should integrate analysis of other parts of the episodic memory system including retrieval. Also long term episodic memory was not assessed as the participants only had to recognize pictures and words that they had recently been exposed to. Additional analysis is required of other aspects of episodic memory using more participants.

References

1. Rugg, M.D., L.J. Otten, and R.N.A. Henson, *The neural basis of episodic memory: evidence from functional neuroimaging.* Philosophical Transactions of the Royal Society B-Biological Sciences, 2002. **357**(1424): p. 1097-1110.
2. Coronado, V.G., L.C. McGuire, K. Sarmiento, J. Bell, M.R. Lionbarger, C.D. Jones, . . . L. Xu, *Trends in Traumatic Brain Injury in the U.S. and the public health response: 1995-2009.* J Safety Res, 2012. **43**(4): p. 299-307.
3. Shum, D., M. Valentine, and T. Cutmore, *Performance of individuals with severe long-term traumatic brain injury on time-, event-, and activity-based prospective memory tasks.* J Clin Exp Neuropsychol, 1999. **21**(1): p. 49-58.
4. Ricker, J.H., R.A. Muller, R.D. Zafonte, K.M. Black, S.R. Millis, and H. Chugani, *Verbal recall and recognition following traumatic brain injury: A [O-15]-water positron emission tomography study.* Journal of Clinical and Experimental Neuropsychology, 2001. **23**(2): p. 196-206.
5. Ricker, J.H., F.G. Hillary, and J. DeLuca, *Functionally activated brain imaging (O-15 PET and fMRI) in the study of learning and memory after traumatic brain injury.* J Head Trauma Rehabil, 2001. **16**(2): p. 191-205.
6. Vos, P.E., L. Battistin, G. Birbamer, F. Gerstenbrand, A. Potapov, T. Prevec, . . . S. European Federation of Neurological, *EFNS guideline on mild traumatic brain injury: report of an EFNS task force.* Eur J Neurol, 2002. **9**(3): p. 207-19.
7. Dennis, M. and H.S. Levin, *New perspectives on cognitive and behavioral outcome after childhood closed head injury.* Dev Neuropsychol, 2004. **25**(1-2): p. 1-3.
8. Rowley, G. and K. Fielding, *Reliability and accuracy of the Glasgow Coma Scale with experienced and inexperienced users.* Lancet, 1991. **337**(8740): p. 535-8.
9. Marion, D.W. and P.M. Carlier, *Problems with initial Glasgow Coma Scale assessment caused by prehospital treatment of patients with head injuries: results of a national survey.* J Trauma, 1994. **36**(1): p. 89-95.
10. Balestreri, M., M. Czosnyka, D.A. Chatfield, L.A. Steiner, E.A. Schmidt, P. Smielewski, . . . J.D. Pickard, *Predictive value of Glasgow coma scale after brain trauma: change in trend over the past ten years.* Journal of Neurology Neurosurgery and Psychiatry, 2004. **75**(1): p. 161-162.
11. Kouloulas, E.J., A.G. Papadeas, X. Michail, D.E. Sakas, and E.J. Boviatsis, *Prognostic value of time-related Glasgow Coma Scale components in severe traumatic brain injury: a prospective evaluation with respect to 1-year survival and functional outcome.* Int J Rehabil Res, 2013.
12. Tateno, A., R.E. Jorge, and R.G. Robinson, *Clinical correlates of aggressive behavior after traumatic brain injury.* Journal of Neuropsychiatry and Clinical Neurosciences, 2003. **15**(2): p. 155-160.
13. Taylor, H.G., K.O. Yeates, S.L. Wade, D. Drotar, T. Stancin, and N. Minich, *A prospective study of short- and long-term outcomes after traumatic brain injury in children: Behavior and achievement.* Neuropsychology, 2002. **16**(1): p. 15-27.
14. Shum, D., E. Jamieson, M. Bahr, and G. Wallace, *Implicit and explicit memory in children with traumatic brain injury.* Journal of Clinical and Experimental Neuropsychology, 1999. **21**(2): p. 149-158.
15. Shum, D., H. Levin, and R.C. Chan, *Prospective memory in patients with closed head injury: a review.* Neuropsychologia, 2011. **49**(8): p. 2156-65.

16. Shallice, T., P. Fletcher, C.D. Frith, P. Grasby, R.S.J. Frackowiak, and R.J. Dolan, *Brain-Regions Associated with Acquisition and Retrieval of Verbal Episodic Memory.* Nature, 1994. **368**(6472): p. 633-635.
17. Kwok, S.C., T. Shallice, and E. Macaluso, *Functional anatomy of temporal organisation and domain-specificity of episodic memory retrieval.* Neuropsychologia, 2012. **50**(12): p. 2943-55.
18. Rugg, M.D. and K.L. Vilberg, *Brain networks underlying episodic memory retrieval.* Curr Opin Neurobiol, 2013. **23**(2): p. 255-60.
19. Wagner, A.D., B.J. Shannon, I. Kahn, and R.L. Buckner, *Parietal lobe contributions to episodic memory retrieval.* Trends in Cognitive Sciences, 2005. **9**(9): p. 445-453.
20. Hillary, F.G., *Neuroimaging of working memory dysfunction and the dilemma with brain reorganization hypotheses.* Journal of the International Neuropsychological Society, 2008. **14**(4): p. 526-534.
21. Cole, D.M., S.M. Smith, and C.F. Beckmann, *Advances and pitfalls in the analysis and interpretation of resting-state FMRI data.* Front Syst Neurosci, 2010. **4**: p. 8.
22. Leopold, D.A. and M. Wilke, *Neuroimaging: Seeing the trees for the forest.* Current Biology, 2005. **15**(18): p. R766-R768.
23. Henson, R.N.A., M.D. Rugg, T. Shallice, O. Josephs, and R.J. Dolan, *Recollection and familiarity in recognition memory: An event-related functional magnetic resonance imaging study.* Journal of Neuroscience, 1999. **19**(10): p. 3962-3972.
24. Chaudhary, U.J., V. Kokkinos, D.W. Carmichael, R. Rodionov, D. Gasston, J.S. Duncan, and L. Lemieux, *Implementation and evaluation of simultaneous video-electroencephalography and functional magnetic resonance imaging.* Magnetic Resonance Imaging, 2010. **28**(8): p. 1192-1199.
25. Sadeh, T., A. Maril, and Y. Goshen-Gottstein, *Encoding-related brain activity dissociates between the recollective processes underlying successful recall and recognition: A subsequent-memory study.* Neuropsychologia, 2012. **50**(9): p. 2317-2324.
26. Montaldi, D. and A.R. Mayes, *The Role of Recollection and Familiarity in the Functional Differentiation of the Medial Temporal Lobes.* Hippocampus, 2010. **20**(11): p. 1291-1314.
27. Kafkas, A. and D. Montaldi, *Familiarity and recollection produce distinct eye movement, pupil and medial temporal lobe responses when memory strength is matched.* Neuropsychologia, 2012. **50**(13): p. 3080-3093.
28. Song, A.W., M.G. Woldorff, S. Gangstead, G.R. Mangun, and G. McCarthy, *Enhanced spatial localization of neuronal activation using simultaneous apparent-diffusion-coefficient and blood-oxygenation functional magnetic resonance imaging.* Neuroimage, 2002. **17**(2): p. 742-50.
29. Cavanna, A.E. and M.R. Trimble, *The precuneus: a review of its functional anatomy and behavioural correlates.* Brain, 2006. **129**: p. 564-583.
30. Trimble, M.R. and A.E. Cavanna, *The role of the precuneus in episodic memory.* Handbook of Episodic Memory, 2008. **18**: p. 363-377.
31. Cavanna, A.E., *The precuneus and consciousness.* Cns Spectrums, 2007. **12**(7): p. 545-552.
32. Lundstrom, B.N., K.M. Petersson, J. Andersson, M. Johansson, P. Fransson, and M. Ingvar, *Isolating the retrieval of imagined pictures during episodic memory: activation of the left precuneus and left prefrontal cortex.* Neuroimage, 2003. **20**(4): p. 1934-1943.

33. Desmond, J. E., & Fiez, J. A. (1998). Neuroimaging studies of the cerebellum: language, learning, and memory. Trends in Cognitive Sciences, 2(9), 355–362.

Detecting Stopping Track Muons with the IceCube Neutrino Observatory

Crispin Contreras, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Douglas Cowen, Ph.D
Professor of Physics
Department of Physics
Eberly College of Science
The Pennsylvania State University

ABSTRACT

Neutrinos have become an important tool in the study of the universe because of their weak interaction with matter, but due to this property it is also difficult to detect them. One way to indirectly detect them is through another particle, the muon. This method is being carried out in the IceCube Neutrino Observatory. Currently the detector has limited information about the interaction of low energy muons and the effect they have on the detectors. It is therefore necessary to study these low energy muons at their minimum ionizing energy to find the probability of them hitting a Digital Optical Module (DOM). This will allow us to calibrate the detector for low energy muons and neutrinos. This was done by using simulated data with the COsmic Ray SImulations for KAscade (CORSIKA) program which runs Monte Carlo simulations.

I. INTRODUCTION

Optical telescopes have been used since the 1600s to probe the cosmos. They have provided us with a wealth of information about our universe. But we are limited by the amount of information we can obtain since they operate in the range of the visible spectrum, which is only a small fraction of the entire electromagnetic spectrum. This problem becomes apparent when one tries to study an object or phenomena that are obstructed by a cloud of dust. Visible light cannot penetrate through matter and this makes it impossible to study such phenomena. There are alternatives to study objects like nebulas (cloud of dust) or other objects that cannot be observed with optical telescopes. Such alternatives are X-ray and radio telescopes which use different electromagnetic wavelengths. These types of telescopes enable us to study objects through most obstructions. But telescopes that use electromagnetic radiation will be affected by objects that will not let the radiation penetrate through even if the wavelength is small. Such problem can be solved by using a different type of telescope, one that depends on a carrier of information which does not interact much with matter or electromagnetic fields. This elusive carrier of information is called the neutrino and it can be studied using a neutrino telescope.

A. Background

Neutrinos are neutral subatomic particles with very small mass. They have become a source of mystery to physicists since very little is known about them and yet they are very abundant in the universe, this opens up the possibility for discovery. There are three types of neutrinos which are the tau neutrino, electron neutrino, and muon neutrino. They are named this way because of the particles the leave behind once they interact with matter. A neutrino can go from one type of neutrino to another through a phenomenon called neutrino oscillations. Neutrino oscillations have allowed us to demonstrate that neutrinos have mass since only things with mass can change over time. In 1998 using Super-Kamiokande, one of the first water based Cherenkov light detectors, confirmed this by studying neutrino oscillations [2]. Now it is estimated that the mass of the neutrino is at least a million times smaller than that of the electron. Because of its small mass, the neutrino is minimally affected by gravity and it is unaffected by electromagnetic fields because it is neutral. The only interaction it has is through the weak interaction force. The interaction with matter is so weak that a neutrino produced in fusion reactions in the sun could go through a light year of lead before having any interaction [2]. Because of its weak interaction with matter the neutrino is ideal to study phenomena which cannot be done using the methods discussed earlier. But how is it detected if a neutrino does not like to interact?

Fortunately there are billions of neutrinos that hit the Earth every second. This means that there is a non-zero probability that a neutrino will be detected. A neutrino can be detected using radiochemical devices or a water based Cherenkov detector. A radiochemical detector is not ideal since it can only give us the count of neutrinos that bombarded the device. It will not give us the direction from which they came from nor the energy [2]. A neutrino observatory that uses Cherenkov light is more useful since this can give us the direction and energy of the neutrino in real time. Cherenkov light is produced when a charged particle travels faster than light in that medium. This produces a cone of light from which the intensity and angle is obtained. We can then tell the energy and the direction it came from with these parameters. The light is usually detected using a photomultiplier tube (PMT). Since the neutrino has a neutral charge it must interact with the nuclei of atoms in the atmosphere or any other medium to produce a charged particle, often a muon. A muon is a charged subatomic particle similar to the electron except for the mass which is much larger and it is often a byproduct of the interaction of neutrinos in the atmosphere or other mediums.

B. The IceCube Detector

For this study the IceCube neutrino observatory was used. IceCube is a 1 km^3-scale Cherenkov light detector deployed in the glacial ice at the geographic South Pole, shown in Figure 1, which uses the ice as a its detection medium. The Cherenkov light is detected by 5160 DOMs frozen in the ice between 1450m and 2450m below the surface of the total volume of $1km^3$. Each DOM consists of a 10in photomultiplier tube (PMT) and the electronics for signal digitization are housed inside a pressure-resistant glass sphere. The DOMs are attached to 86 strings that provide mechanical support, electrical power, and a data connection to the surface [1]. The DOMs are separated by 17m vertically in the string and the strings are horizontally separated by 125m. The construction of IceCube began in 2005 and it was completed in 2010.

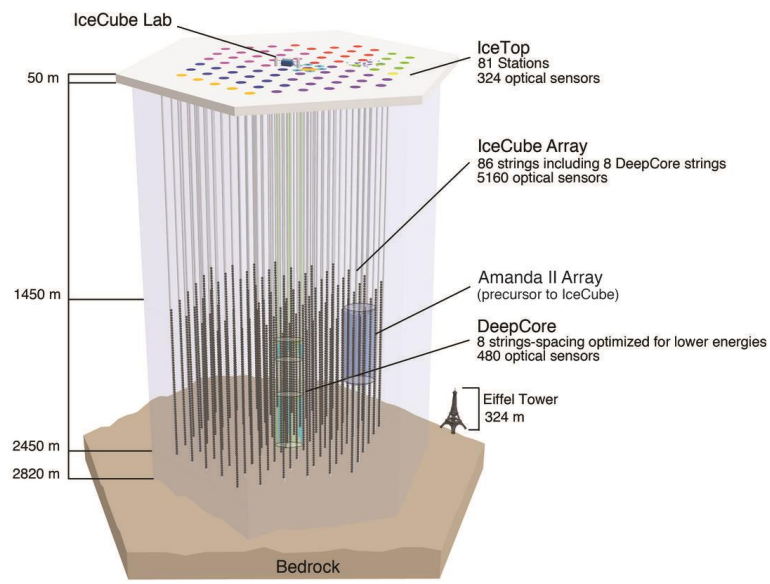


Figure 1: Artist's rendition of the IceCube Observatory [1]

The DOMs are responsible for capturing and digitizing real time pulses from the PMT and when requested transmitting the data to the surface data acquisition (DAQ) system. The DAQ is responsible for messaging, keeping the dataflow, filtering, monitoring, calibration, and implementing the control functions [4]. Most of the data acquired by the DAQ is noise, which it discards, but when it finds an interesting event it will report it. The noise might be other charge particles that are not desirable, but it could also include interesting events that could occur at low energies.

C. Theory

A muon loses energy as it transverse through the ice due to ionization. Since the muon is charged it creates an electric field which interacts with the outer electrons of the atoms in the ice. This interaction might knock out some electrons or it might excite them, as this occurs the muon loses energy. The energy loss per meter, for a muon propagating through ice, is related to its energy:

$$-\langle\frac{dE}{dX}\rangle = \alpha(E) + \beta(E)E \qquad (1)$$

where E is the muon energy, $\alpha \approx 0.24 GeV/m$ is the ionization energy loss per unit length, and $\beta \approx 3.3 \times 10^{-4} m^{-1}$ is the radiative loss through bremsstrahlung, pair production, and photonuclear scattering [5]. Since most of the muons I will be studying are in the GeV range they will not be affected by radiative loss, also most muons will stop within 1000 meters in the detector.

For this reason it is necessary to study the behavior of muons in the ice and the effects that they have on the DOMs. It is possible that the DAQ could be filtering out some low energy muons. I will be looking at low energy muons in the GeV (giga-electronvolt) range that may stop within the detector. I will isolate a sample of muons near the point where they are minimally ionizing. The behavior of these types of muons is well understood in different forms of matter, but not in the detector [7]. So it will be necessary to run multiple simulations to recreate their paths and measure the probability that they will hit a DOM. The findings of this study will

enable us to calibrate the detector for low energy muons which will help us detect neutrinos that are in this range of energy too. Studying neutrinos at this range of energy will help us understand their fundamental properties.

II. METHODS

To analyze the data I will use IceTray which is the framework developed by the IceCube collaboration. A framework is a set of rules, interfaces, and services provided to the programmer who can use it to perform a set of tasks [5]. In a modular framework the user only changes a few lines in a command file to modify the analysis chain. A programmer can then implement algorithms and the framework will figure out how they will interact. This means that in a modular approach each subsystem can be modified, added or replaced without altering others. The IceTray framework follows these principles and it consists of modules which are independent code units that can be used to obtain data or to manipulate it. These modules can then be linked into the framework which can be used later. Once an event in the detector is found it is then stored in data containers called frames which can be processed using the modules. This framework is used for simulation, reconstruction of events, and for developing IceCube applications.

The data used was simulated using CORSIKA which is a detailed Monte Carlo program used to study the evolution of extensive air showers initiated in the atmosphere by photons, protons, nuclei, or any other particle [3]. This program is then able to generate the paths and energies of the particles. The files that I used had proton and other primary particle which generated muons. It was then necessary to use one of the modules in IceTray to begin the process of isolating the low energy muons. To do this we needed to use the single photoelectron (SPE) fit, which is a likelihood reconstruction that uses the arrival time of the first photoelectrons in all hit DOMs [5]. A photoelectron is an electron emitted from the PMT when light hits it. With this reconstruction I will be able to obtain the direct length and total charge. The direct length is the length of the track, which is the distance along the track from the first hit DOM to the last hit DOM from the light perpendicular to the track direction. The total charge is the number of photoelectrons detected in by the DOM. I also used steamshovel, which is an event viewer able to display the track of the muon and the angle at which it enters the detector. This will allow me to make cuts from my data and only study stopping track muons which have low energy.

Once a sample of low energy muons has been isolated the probability of them hitting a DOM can be obtained. This can be done by studying the track of the muons. This result will allow us to know how many of these type of events can be detected by the DOMs. I also used ROOT which allowed me to output this data into histograms. ROOT is data analysis software which uses C++ and is a standard tool for analyzing data graphically in the particle physics community.

III. RESULTS

Applying the SPE fit to the CORSIKA files I obtained 19310 events. I was then able to obtain the variables of length direct and total charge using the common variables script which calculated them. These were then plotted, Figure 2 shows the results. This plot was used to determine how many events have a small direct length and total charge which is a characteristic of stopping track muons. All of the events were within the length of 1500m which is largest

length a track can have within the detector. The plot shows that there is a large amount of events that have small length and charge which could be stopping track muons. But it is also possible that these events might be due to muons hitting the corners of the detector (corner clippers) which will also register as a small length and charge. The next step is to then study these muons that have a small length and charge. This was done with the IceTray module steamshovel.

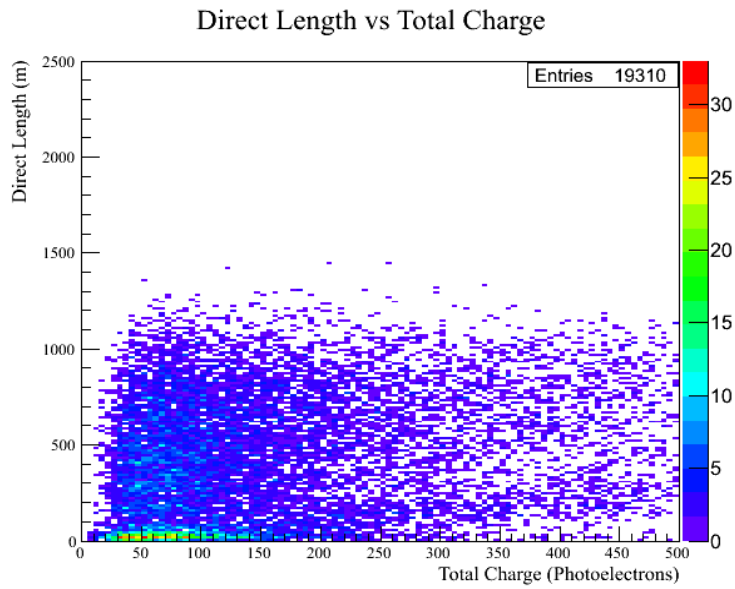


Figure 2: The scatter plot shows the Direct Length vs. The total charge (number of PE detected) detected. The color scale indicates the number of events in each bin.

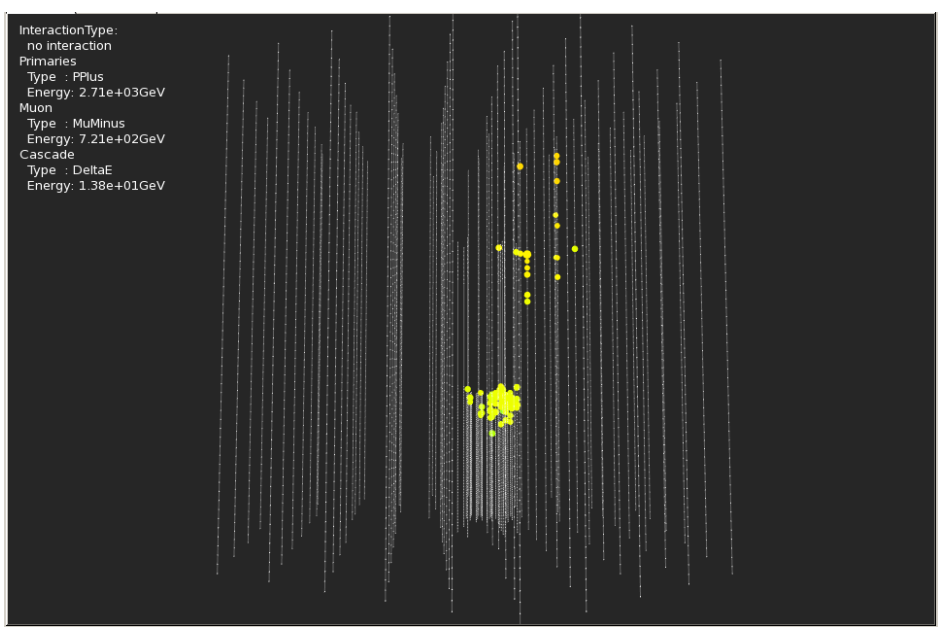
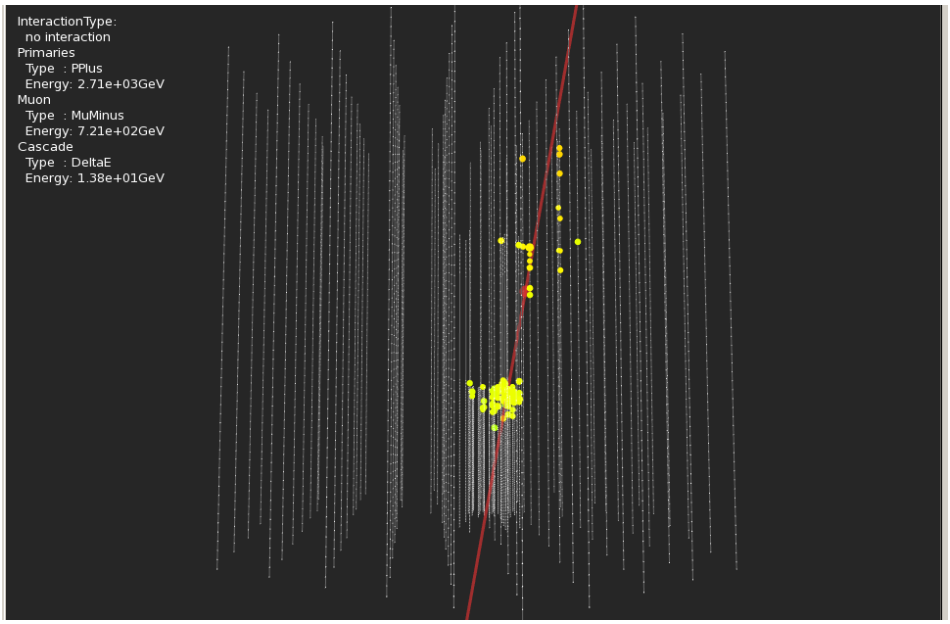
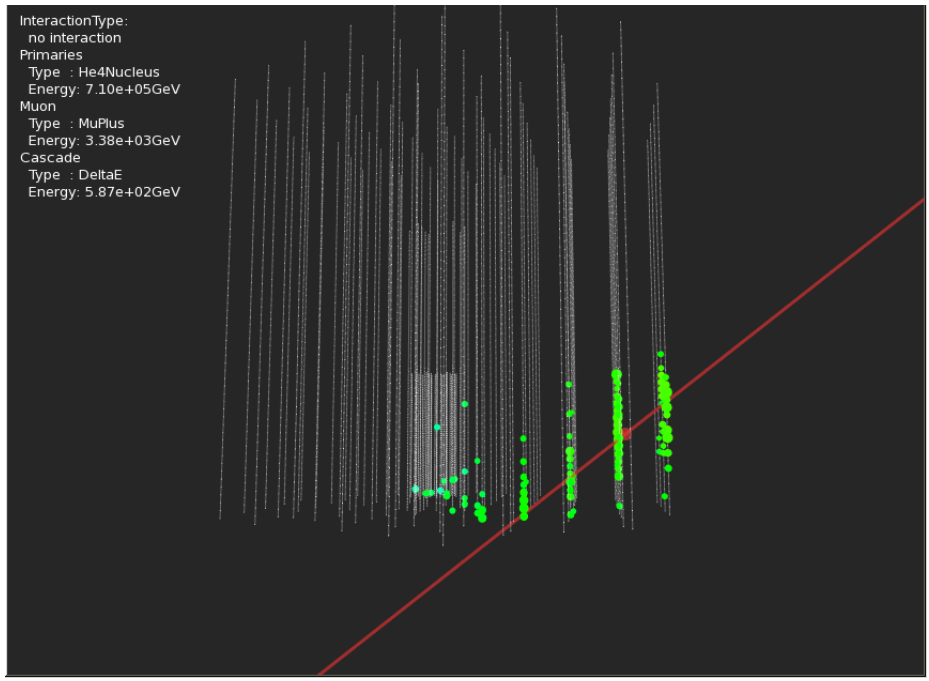


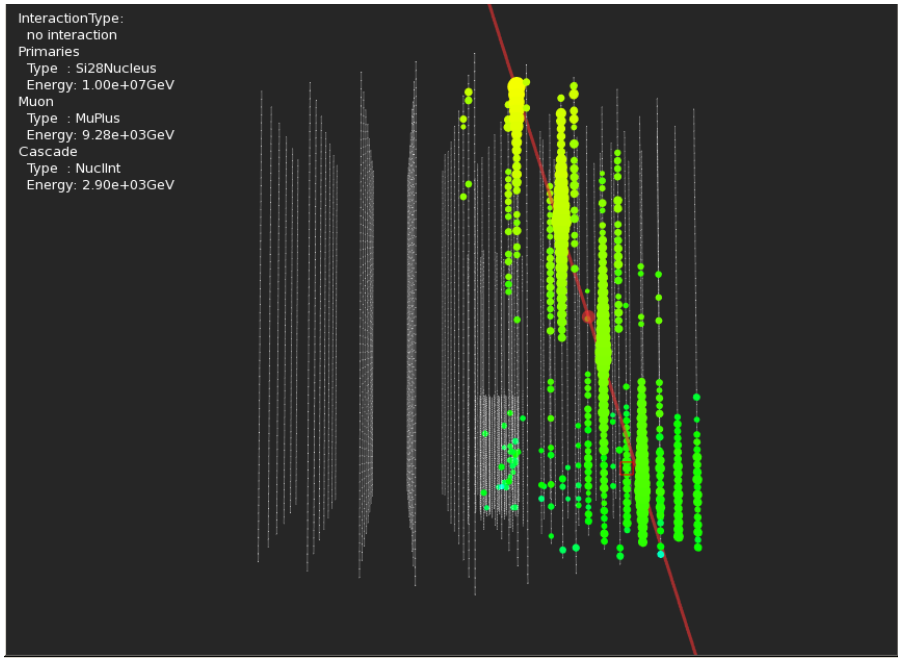
Figure 3: This is a picture of a simulation of a muon stopping in the detector. This simulation shows the energy the muon has and the effect it has on the DOMs.


InteractionType:
no interaction
Primaries
Type : PPlus
Energy: 2.71e+03GeV
Muon
Type : MuMinus
Energy: 7.21e+02GeV
Cascade
Type : DeltaE
Energy: 1.38e+01GeV

(a)


InteractionType:
no interaction
Primaries
Type : He4Nucleus
Energy: 7.10e+05GeV
Muon
Type : MuPlus
Energy: 3.38e+03GeV
Cascade
Type : DeltaE
Energy: 5.87e+02GeV

(b)

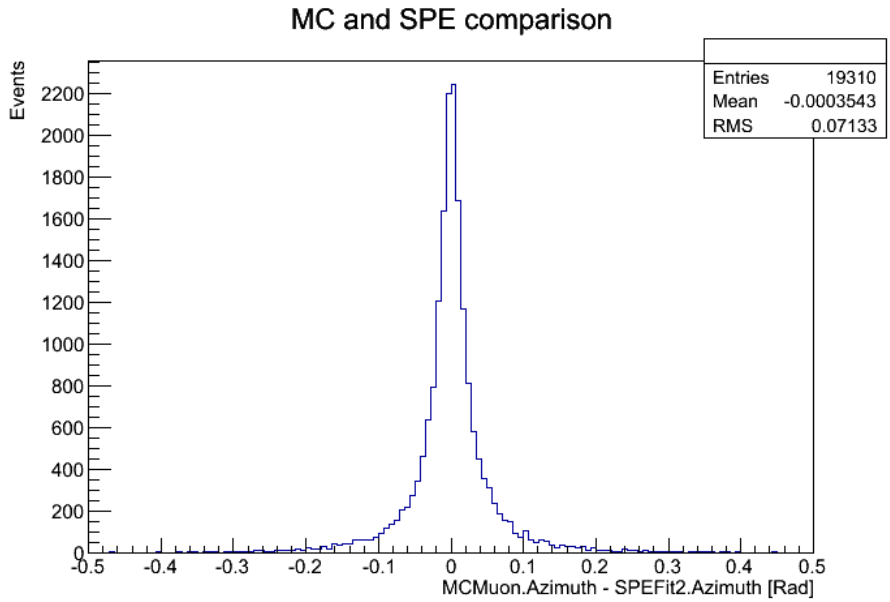


(c)

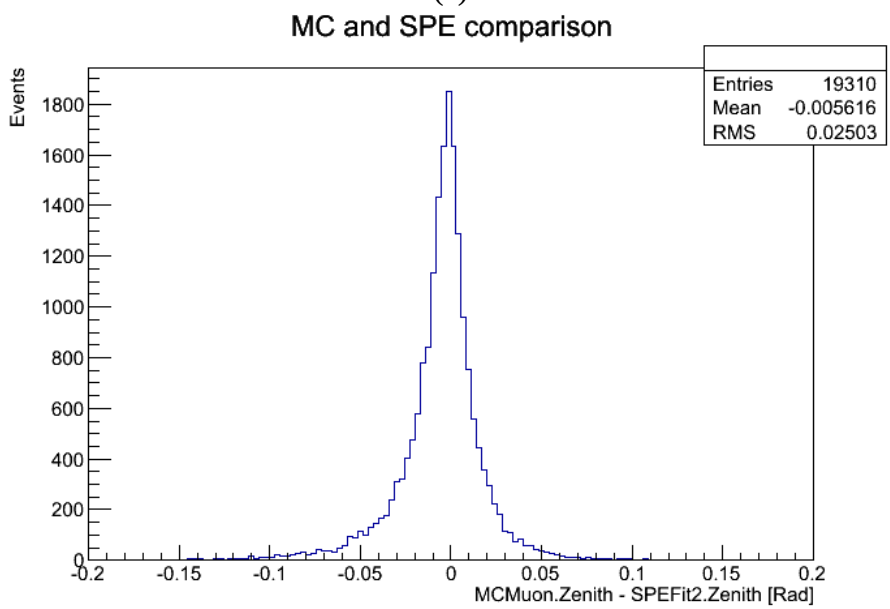
Figure 4: (a) Simulation with the SPE fit reconstruction which shows a track of a stopping muon. (b) The track of corner clipper muon. (c) The track of a muon that goes through the detector

Steamshovel displays the track of the muon and the Cherenkov light it deposits on the DOMs. The DOMs are displayed by the dots and the different colors show the time of arrival in the event. Red color indicates that light arrived early in the event while blue color means it arrived late. This is used to check if the reaction of the DOMs are related and caused by the same muon. Also the charge detected by the DOMs is shown by the size of the colored spheres. A large sphere will indicate large amounts of charge while a small sphere will indicate small charge. Figure 3 shows a picture of the event viewer which has a simulation of a muon. This figure only shows the reaction of the DOMs. Figure 4 (a) shows the path reconstructed from the reaction of the DOMs which is what the SPE fit script calculated. The picture of the simulation shows that the muon stops within the detector. Figure (b) and (c) show the events that need to be cut: (b) shows the track of a muon clipper which has a small length and charge. These type of events need to cut since they are not stopping in the detector. Also the muons that go through the detector are not needed; such events are similar to Figure 4 (c).

In order to check if the SPE Fit constructed the events correctly it was necessary to compares the angles outputted with those of the CORSIKA simulation. I decided to use both the zenith and azimuth angles to include all the directions a particle can enter through the detector. The zenith angle has a range of 0°-180° and is measured from the top of the detector to the bottom. The azimuth has a range of 0°-360° and is measured around the detector. To compare these two angles it was necessary to get the difference between them as shown in Figure 5 (a) and (b). A good reconstruction will have a difference of zero. In (a) the majority of the events were within the ranges of$\pm 0.1\ rad$, this is the same as$\pm 5.73°$. For (b) these values are then $\pm 0.05\ rad$ which is$\pm 2.86°$. This values show that the reconstruction was good since there is not much angle separation.



(a)



(b)

Figure 5: The histograms show the difference between the angles from the Monte Carlo (MC) simulation and the SPE fit at which the particle entered the detector. (a) This shows the difference between the azimuth angles and (b) shows the difference between the zenith angles.

Since the reconstruction was generated correctly I made cuts on the data and selected the events that had a length of 800m and total charge of 200. This gave me a total of 2951 events. I compared the number of stopping muon with and without the cuts. I did this by using the point where the muon entered the detector and the distance it traveled. I looked at muons that stop within 1550m and 2350m in the detector. I obtained 741 muons out of 19310 events that stop without the cut and 356 out of 2951 with the cut. This are very few muon which means that the cut might be getting rid of a lot of muons that might be stopping in the detector or that most of

the muons are very energetic. It is therefore necessary to implement a new cut on the number of events or use a different set of data.

IV. CONCLUSION

The data processed was selected to include only low energy muons. The values of the SPE fit and MC were compared to show that the reconstruction was adequate. The results show that they were. Finally a percentage of the total muons that stop within the detector was determined with and without the cut. A larger percentage of muons with the cut was found but the number of muons is very low. In order to have an accurate probability of a DOM getting hit a larger number of muons is needed. Therefore a better method for the cut is needed or it is also possible to get a large number by studying a different range of the direct length and total charge.

References

[1] Aartsen, M.G., R. Abbasi, Y. Abdou, M. Ackermann, J. Adams, J.A. Aguilar, M. Ahlers, et al. "Measurement of South Pole Ice Transparency with the IceCube LED Calibration System." *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 711 (May 21, 2013): 73–89. doi:10.1016/j.nima.2013.01.054.

[2].Besson, D., Cowen D., Selen M., and Wiebusch C.. 1999. "Neutrinos." *Proceedings of the National Academy of Sciences of the United States of America* 96 (25) (December 7): 14201–14202.

[3] Heck, D., J. Knapp, J. N. Capdevielle, G. Schatz, and T. Thouw. "CORSIKA: A Monte Carlo Code to Simulate Extensive Air Showers." Accessed July 15, 2013. http://147.91.68.104/CORSIKA_PHYSICS.pdf

[4] IceCube Collaboration. Preliminary Design Document http://icecube.wisc.edu/icecube/static/reports/IceCubeDesignDoc.pdf

[5] IceCube Collaboration, R. Abbasi, Y. Abdou, T. Abu-Zayyad, J. Adams, J. A. Aguilar, M. Ahlers, et al. *Measurement of the Atmospheric Neutrino Energy Spectrum from 100 GeV to 400 TeV with IceCube*. ArXiv e-print, October 19, 2010. http://arxiv.org/abs/1010.3980.

[6] Kopper, C. "A Software Framework for KM3NeT." *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 602, no. 1 (April 11, 2009): 107–110. doi:10.1016/j.nima.2008.12.047.

[7] Particle Data Group, J. Beringer, J. -F. Arguin, R. M. Barnett, K. Copic, O. Dahl, D. E. Groom, et al. "Review of Particle Physics." *Physical Review D* 86, no. 1 (July 20, 2012): 010001. doi:10.1103/PhysRevD.86.010001.

The Implications of Early Family Experiences for Adolescents' Perceived Romantic Competence

Kenya S. Crawford, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Susan M. McHale, Ph.D
Social Science Research Institute Director
Children, Youth and Families Consortium
Human Development Professor
The Pennsylvania State University

Christine E. Stanik, Ph.D
Post-Doctoral Scholar
Human Development and Family Studies
The Pennsylvania State University

Abstract:

Cultivating healthy romantic relationships is an important component of development. Youth's perception of their competence plays a vital role in navigating these relationships. This study examined the effects of early family experiences, including both marital relationship dynamics and parent-child relationship quality, on adolescent perceived romantic competence. The data was drawn from a longitudinal study that tracked 201 families which included mothers', fathers' and their first born and second born children (studied from middle childhood through adolescence). All of the subjects identified as European American, but represented a range of working class and middle class families. Results from regression analyses revealed that as mothers' reports of marital conflict increased adolescents' reports of romantic competence decreased. Results also revealed that adolescents' reports of intimacy with mothers' was positively related to romantic competence.

Introduction

In the early 20th century, the Western cultural practice of adolescent romantic relationships emerged (Collins, Welsh, & Fuman, 2009). Cultivating healthy romantic relationships is an important component of development (Smetana, Campione-Barr, & Metzger, 2006). As a recent phenomenon, adolescent romance has received little scholarly attention (Giordano, Longmore, & Manning, 2006). The short duration of these relationships may partially account for why there is a lack of research on this topic (Collins et al., 2009). Adolescent romantic experiences have been linked with aspects of individual development and adjustment, including identity formation, satisfying peer relationships, and sexual identity development (Mueller, 1980; Smetana et. al, 2006). Any number of these factors affects the quality of romantic relationships in adolescents, which warrants researchers' attention (Furman & Collins, 2009). This project examines the connection between adolescents' early childhood experiences and their young adolescent romances.

Given that adolescent romantic relationships are typically short-lived, which makes them difficult to address, researchers have begun to turn their attention to the related concept of perceived romantic competence. Romantic competence refers to the ability to "facilitate the acquisition, development, and maintenance of mutually satisfying relationships (Hansson, 1984). Romantic competence has been linked to measures of passion, intimacy and commitment in romantic relationships (Shulman, Davila, & Schachar-Shapira, 2011). Romantic competence is also associated with positive features of relationship experiences that are typically reflective of high quality relationships (Shulman, Davila, & Schachar-Shapira, 2011). The aim of the current study was to explore linkages between family experiences in early childhood and perceptions of romantic competence.

Our research draws on data from a sample of 201 families with children that were studied longitudinally from middle childhood through late adolescence. Participating families all consisted of two married parents, with two siblings that were about one to four years apart in age. Given the ages of interest in the current study, we focused exclusively on the older sibling. Two domains of family experiences were investigated. First, we used the Social Learning framework to evaluate the impact of parents' marital quality on romantic competence (Brauer & Tittle, 2012). Next, attachment framework (Bowlby, 1969) enabled us to assess how the quality of parent-child relationships affected romantic competence in adolescence.

Literature Review

Social Learning Theory

According to Social Learning Theory, people tend to observe and model the behaviors, attitudes and emotional reactions of others (Brauer & Tittle, 2012). Parents' relationships may serve as a model for how adolescents interact with their romantic partners. Children from high-conflict homes experience more adjustment problems over time compared to children from low conflict homes (Booth & Amato, 2001; Harold, Shelton, Goeke-Morey, & Cummings, 2004). Children from families with high parental discord typically have more difficulties in dating, less happiness, less interaction and more conflict in marriage (Amato, 2007). Therefore, when a marriage begins to suffer the children in the family are affected tremendously. Since negative family experiences affect adolescents in the future, this study aims to determine how early family experiences will affect future romantic competence. It's predicted that higher reports of marital conflict between parents will results in lower reports of romantic competence in adolescents. On the other hand, this theory has also lead to our second hypothesis that high reports of marital love will result in higher levels of romantic competence.

Parent-Child Relationship Quality

Attachment Theory has been used to understand that bonds between an infant and their care taker help establish the strength of their relationship (Bowlby, 2005). This theory states that attachment styles play a vital role from childhood through adulthood (Bowlby, 1969). Relations with parents during early periods of development have been correlated with the stability and quality of early adult romantic relationships (Simpson, Collins, Tran, & Haydon, 2007). Children who have strong bonds with parents typically have healthier romantic relationships in their young adulthood. (Collins & Sroufe, 1999). Drawing from attachment theory, we will study how the quality of parent-offspring relationships may affect romantic competence. Therefore, this study aims to investigate, if the quality of relationships with parents affects romantic competence in adolescents. In particular, it was hypothesized that there would be a correlation between

adolescent-parent relationship quality (i.e., the emotional tone of dyadic exchanges) and the adolescent's romantic competence.

Guided by previous research it is expected that children who witness high marital conflict between their parents will report lower levels of romantic competence. The literature has led to these expectations because children from families with high parental marital conflict are more likely to have issues with dating and marriage (Amato, 2007). Previous research has also led to the prediction that children who have a strong quality relationship with their parents will report higher levels of romantic competence.

Methods

Participants

Data for this research were drawn from a longitudinal study aimed at exploring family relationships and gender development from middle childhood through adolescence. By using a longitudinal design we were able to detect developmental changes. Conducting surveys ensured anonymous and confidential responses. Participants were fathers, mothers, and their first and second born children. These families were predominately European American working and middle class married families living in small towns in a northeast state. Though the sample was in some ways not representative of the average U.S. families it reflected the socio-demographic profile of families from the region of the northeast state where the data had been collected. Families were recruited via letters that were sent through schools to families with 4th and 5th grade children. These letters gave a detailed description of the study and the criteria for participation. Families that wished to participate returned a self-addressed postcard and completed a follow-up telephone screening. Of the eligible families ninety percent agreed to participate.

The sample included 201 families. At Time 1 the average age of mothers was 36.66 (*SD* 3.92) and the average age of fathers was 38.92 (*SD*=5.00). Average family size was 4.54 (*SD*= .75) and most families (>80%) included two or three children. Fathers' education level averaged 14.67 (*SD*= 2.43) and mothers' averaged 14.57 (*SD*= 2.15), a score of 12 represented high school graduate, 14 represented some college, 16 represented a bachelor's degree. Given that the study focused on dual-earner families' the majority of the parents held employment (92% of mothers' and 100% of fathers'). Mothers' typically worked part time jobs and fathers' held full time jobs (mothers', *M*= 28.55, *SD*= 16.03; fathers', *M*= 47.82, *SD*= 10.99). The total family income averaged $28,612.84. Marital duration average was 13.59 years (*SD*=2.44).The older siblings averaged 16.47 years (*SD*= 0.79), and younger siblings' age averaged at 13.89 years (*SD*=1.15). There was roughly an equal amount of boys and girls (103 boys, 98 girls).

Procedures

Every year of the study a team of interviewers conducted separate home interviews with mothers, fathers and the two siblings. Participants were asked questions regarding their personal qualities and family relationships. Home interviews were conducted on eight various occasions over a 10 year period. Based on our interest our analysis was limited to phases 1, 2, 3, and 6. After data collection was completed families received a $100 or $200 honorarium depending on the study phase.

Parents' marital quality

Each year mothers' and fathers' reported on conflict and love in their marital relationship. The Marital Interactions Scale (Braiker & Kelley, 1979) was used to measure marital conflict. Items (e.g., "How often do you and your partner argue with one another?") were rated on a 9-point scale from *not at all* or *never* to *very much* or *very often*. Love was also measured on The Marital Interactions Scale (Braiker &Kelley, 1979). Items (e.g., "To what extent do you love your partner at this stage?") were rated on a 9-point scale from *not at all* to *very much*. Cronbach alpha for love was .90 -.92 and conflict was .56 -.77

Parent-offspring relationship quality

Intimacy and conflict between adolescents and their parents was measured each year. Intimacy with mothers and fathers was measured by using an eight-item measure created by Blyth, Hill and Thiel (1982). Some items included "How important is your mother/father to you?" which were rated on a five-point scale. Conflict with mothers and fathers was measured by the frequency of conflict which was rated on 6-point scale. Cronbach alpha for older siblings intimacy with their mother and father was .76 - .81 and conflict between older sibling and their mother and father was .80 -.85.

Romantic Competence

The Harter (1982) five-point scale was used to assess adolescents' perceived romantic competence. Items for this measure instructed adolescents to read two statements then select the teenager they most identified with (e.g. "Some teenagers feel that they would be fun and interesting on a date but other teenagers wonder about how fun and interesting they would be on a date"). Then adolescents were asked if they felt the statement was "*really true"* or "*somewhat true".* The response scale ranged from 1-4, with a score of one portraying a low competence score and a score of four indicating a high perceived competence. Cronbach alpha was .80.

Results

Our results have been organized around our research goals, (1) To determine the effects of marital quality on adolescent romantic competence; (2) to examine parent-offspring relationship qualities as predictors of romantic competence. In order to address these goals we used a series of regression analyses. To avoid issues with multi-collinearity substantive predictors were entered into separate models.

Preliminary analyses showed various relationships between the variables of this study (see Table1). These analyses showed that parents tended to report high levels of martial love. Reports also showed that boys reported higher levels of romantic competence, compared to girls.

To achieve our first goal of determining the effects of marital quality on adolescent romantic competence, we conducted a regression analysis. Marital quality stood as the predictor variable and adolescent perceived romantic competence as the outcome variable. Our first step was to enter marital love and marital conflict as the predictor variables to examine the extent to which marital quality affected adolescent romantic competence.

In order to test our second goal of the influences of parent-offspring relationship qualities on romantic competence, we performed another set of regression analyses. The predictor variable stood as parent-offspring relationship quality and adolescent romantic competence as the outcome variable.

We found that mothers' reports of marital conflict were negatively associated with youth's reports of romantic competence (see Table 2). Consistent with our expectations, these results support our hypothesis that negative marital quality will result in lower reports of adolescent romantic competence. Inconsistent with our expectations, however fathers' reports of marital love were not associated with youth's romantic competence (see Table 3). It was also found that there were no significant associations between mothers' marital love, fathers' marital conflict, and perceived romantic competence (see Table 5).

Our results revealed that adolescents who reported high levels of intimacy with their mothers' during early childhood reported higher romantic competence during adolescence (see Table 4). In accordance with our predictions, these results supported our hypothesis that positive relationships with parents tend to increase reports of romantic competence. There was no correlation found between father-child relationships and adolescent perceived romantic competence (see Table 5). Overall, marital conflict and parent-offspring relationships typically predict adolescent romantic competence.

Discussion

In sum, our research aimed to close a gap in the literature by examining the implications of early family experiences and perceived adolescents' romantic competence. First our results reveled that negative family experiences are correlated with lower perceived adolescent romantic competence. Specifically, mothers' reports of marital conflict were found to be negatively related to adolescent romantic competence, yet marital love was not found to be positively related to adolescent romantic competence. Previous research has shown that marital conflict has been linked to adjustment problems including aggression, noncompliance and maladjustment in adolescents (Long, Forehand, Fauber, & Brody, 1987; Jouriles et al., 1989; Wierson, Forehand, & McCombs, 1988**)**. Marital conflict may present stronger predictions for levels of romantic competence because marital conflict may be more apparent and detrimental to youth. Since marital conflict has such great effects on children, marital love may not affect children as much. It has been found that strong marriages benefit children in multiple ways; a higher standard of living, exposure to effective and cooperative parenting, and less stress overall (McGuinness, T. M. 2006). Yet, there is very little research, if any, stating the relationship between parents' positive marital quality and adolescent romantic competence. Therefore positive marital quality may affect children in other ways, not including romantic competence. Explaining why our results showed no relationship between positive marital quality (parents' reports of love) and adolescent romantic competence.

Our results have shown that fathers' reports of marital quality and father-offspring relationship had no impact on adolescent romantic competence. To understand the lack of connection between marital quality and romantic competence, one must take into account that men who have employed wives tend to present greater happiness in their relationships (Booth & Amato, 1995). Therefore low levels of marital conflict may explain why fathers' reports weren't found to be related to romantic competence. Father-offspring relationships typically have different impacts compared to mother-offspring relationships. Research has consistently shown that fathers spend far less time with their children compared to mothers' (Lamb, M., 2004). Fathers have also been found to more directly affect families financially instead of socially and emotionally (Lamb, M., 2004). This lack of connection between fathers' and children may result in the little influence on adolescent romantic competence.

This study has revealed a positive relationship between mother-offspring intimacy and romantic competence. Previous literature shows that weak relationships between children and their parents can lead to various issues including academic, social, and mental challenges (Dillam, Purswell, Lindo, Jayne, Fernando, 2011). Therefore these results add to the literature by showing the positive effects of strong mother-offspring relationships.

Future Research

In order to effectively determine the cause of these results additional research needs to be done. To determine why fathers' may not implicate adolescent romantic competence father-offspring relationships require additional scholarly attention. It may be beneficial to replicate this study, and only focus on the implications of fathers' absence and romantic competence. To understand why marital love wasn't related to adolescent romantic competence future studies may focus on families with atypical high and or low reports of love. The parents included in this study were all married for over 10 years. The parents in this study presented low variability of marital quality in their marriages which may have resulted in the lack of relationships with romantic competence. Therefore studying families with variation in marital love may present a deeper understand as to why marital love showed no relationship to romantic competence.

Limitations

The present study had several limitations that should be addressed in future research. First our sample included working/middle class, European American two-parent families. It's imperative that future studies examine diverse families in terms of culture and financial backgrounds. Currently there is very little research focusing on adolescents from low-income or minority families. Indicators of poverty like unemployment and perceived financial instability have been associated with the quality of long-term stability of romantic relationships (Conger, Wallace, Sun, Simmons, McLoyd, & Brody, 2002). Therefore poverty may negatively affect marital quality, which has been found to lower adolescents' romantic competence. Given these difference, it would be beneficial for future work to replicate our findings with diverse samples. Next, our analyses were limited to self-reports' of marital quality and parent-offspring relationships. By using self-report scales we have relied on the honesty of our participants. It's not uncommon for participants to alter responses to be socially acceptable. (Fan, Miller, Park, Winward, Christensen, Grotevant, 2006). To combat this limitation one may want to observe families in personal settings or include peer reports of participants' romantic competence. The reliability of this study may also be increased if the sample size was increased. Also during this study we did not control for the number of previous adolescents' romantic relationships. Therefore some responses may be based on very few or several romantic relationships. To prevent this limitation in the future the amount of romantic relationships should be controlled. An additional recommendation for future research would be to control for current relationship status. Focusing on adolescents who are currently dating may present variation in romantic competence. Nonetheless, these limitations played a small role on the results.

Conclusion

In sum, our research adds to the literature on the implications of early family experiences on perceived adolescent romantic competence. This study also expands adolescent romantic

competence research in new directions. Although our research is not conclusive, it poses an important connection between early family experiences and adolescent romantic competence. Given the relationship between family experiences and adolescent romantic competence provides promising direction for future research on this intriguing topic.

Table 1

Means (SDs) and correlations for study variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	M(*SD*)
1. Romantic Competence	-												2.49(.75)
2. Marital Love (Mothers)	-.09	-											69.78(9.06)
3. Marital Love (Fathers)	-.008	.53***	-										68.35(8.43)
4. Marital Conflict (Mothers)	-.09	-.48***	-.36***	-									19.51(5.65)
5. Marital Conflict (Fathers)	.02	-.42***	-.46***	.50***	-								18.82(4.27)
6. Mother-offspring Intimacy	.12	.02	.06	-.09	-.04	-							31.02(3.79)
7. Father-offspring Intimacy	.05	.15*	.10	-.11	-.04	.53***	-						29.44(4.13)
8. Mother-offspring Conflict	-.15**	.03	-.03	.11	.02	-.19***	-.18**	-					27.27(6.65)
9. Father- offspring Conflict	-.11	.06	.03	.07	-.01	-.11	-.15*	.82***	-				24.31(6.59)

10. Offspring Gender	.17**	-.17**	-.19***	.17*	.13	-.08	.19**	.04	.06	-			1.49(.5)
11. Mothers Education	-.04	-.11	-.03	.09	-.05	.07	-.01	-.006	-.06	-.09	-		14.57(2.15)
12. Fathers Education	.09	-.06	-.02	-.02	-.04	-.04	-.03	.05	-.05	-.09	.58***	-	14.67(2.43)
13. Offspring Age	.07	-.01	.04	.03	.11	-.13	-.09	-.05	-.01	.11	-.03	-.09	10.87(.54)

*p < .05 **p ≤ .01 *** p ≤ .001

Table 2

Coefficients and (SE's) for models testing parents marital conflict as a predictor of romantic competence

Variable	Romantic Competence	
	B	*SE B*
Marital Conflict (Mothers)	-.02*	.01
Marital Conflict (Fathers)	.01	.01
Offspring Gender	.27**	.11
Mothers Education	.07	.07
Fathers Education	.01	.03
Offspring Age	-.03	.03
R^2		.06
F(186)	1.95	

*p < .05 **p ≤ .01 *** p ≤ .001

Table 3

Coefficients and (SE's) for models testing parents marital love as a predictor of romantic Competence

Variable	**Romantic Competence**	
	B	*SE*
Marital Love (Mothers)	-.008	.007
Marital Love (Fathers)	.007	.007
Offspring Gender	.247*	.113
Mothers Education	.0004	.03
Fathers Education	-.02	.03
Offspring Age	.06	.07
R^2		.05
F (187)	1.63	

*p < .05 **p ≤ .01 *** p ≤ .001

Table 4

Coefficients and (SE's) for models testing parent offspring intimacy as a predictor of romantic competence

Variable	Romantic Competence	
	B	*SE B*
Mother-offspring Intimacy	.04*	.02
Father-offspring Intimacy	-.01	.02
Offspring Gender	.28**	.11
Mothers Education	-.003	.03
Fathers Education	-.02	.03
Offspring Age	.07	.07
R^2		.06
F(189)	2.09	

*p < .05 **p ≤ .01 *** p ≤ .001

Table 5

Coefficients and (SE's) for models testing parent offspring conflict as a predictor of romantic competence

Variable	**Romantic Competence**	
	B	*SE B*
Mothers-offspring Conflict	.007	.01
Fathers-offspring Conflict	-.01	.01
Offspring Gender	.25*	.11
Mothers Education	.004	.03
Fathers Education	-.02	.03
Offspring Age	.05	.07
R^2		.05
F(189)	1.62	

*p < .05 **p ≤ .01 *** p ≤ .001

References

Amato, P. R. (2007). *Alone together: How marriage in America is changing*. Cambridge, Harvard University Press.

Brauer, J., & Tittle, C. (2012). Social learning theory and human reinforcement. *Sociological Spectrum, 32*(2), 157-177. doi:10.1080/02732173.2012.646160

Blyth, D. A., Hill, J.P., & Thiel, K.S. Early adolescents' significant others: Grade and gender differences in perceived relationships with familial and nonfamilial adults and young people. *Journal of Youth and Adolescence* 1982, 11, 425-450

Booth, A., & Amato, P. R. (2001). Parental predivorce relations and offspring post-divorce well-being. Journal of Marriage and Family, 63, 197–212

Bowlby, J. (2005). *A Secure Base: Clinical Applications of Attachment Theory* (Vol. 393). Taylor & Francis US.

Bowlby, J. (1969) *Attachment and loss, Vol. 1: Attachment.* New York: Basic Books

Braiker H., & Kelley, H. H. (1979). Conflict in the development of close relationships. In R. L. Burgess & T. L. Huston (Eds), *Social Exchange in developing relationships (*pp. 135-186). San Diego, CA: Academic Press

Collins, W. A., Welsh, D. P., & Furman, W. (2009). Adolescent romantic relationships. *Annual Review of Psychology, 60*(1), 631-652. doi:10.1146/annurev.psych.60.110707.163459

Collins, W. A., & Sroufe, L. A. (1999). Capacity for intimate relationships. *The development of romantic relationships in adolescence*, 125-147.

Conger, R. D., Wallace, L. E., Sun, Y., Simons, R. L., McLoyd, V. C., & Brody, G. H. (2002). Economic pressure in African American families: A replication and extension of the family stress model. Developmental Psychology, 38, 179–193.

Dillman Taylor, D., Purswell, K., Lindo, N., Jayne, K., & Fernando, D. (2011). The impact of child parent relationship therapy on child behavior and parent-child relationships: An examination of parental divorce. *International Journal of Play Therapy, 20*(3), 124-137. doi:10.1037/a0024469

Giordano, P. C., Longmore, M. A., & Manning, W. D. (2006). Gender and the meanings of adolescent romantic relationships: A focus on boys. *American Sociological Review, 71*(2), 260-287. doi:10.1177/000312240607100205

Harter, S. (1982). The perceived competence scale for children. *Child development*, 87-97.

Jouriles, E. N., Murphy, C. M., Farris, A. M., Smith, D. A., Richters, J. E., & Waters, E. (1991). Marital adjustment, parental disagreements about child rearing, and behavior problems in boys: Increasing the specificity of the marital assessment. *Child development*, *62*(6), 1424-1433.

Lamb, M. E. (2004). *The role of the father in child development*. Hoboken, N.J: J. Wiley.

Long, N., Forehand, R., Fauber, R., & Brody, G. H. (1987). Self-perceived and independently observed competence of young adolescents as a function of parental marital conflict and recent divorce. *Journal of Abnormal Child Psychology*, *15*(1), 15-27.

McGuinness, T. M. (2006). Marriage, divorce, and children. *Journal of Psychosocial Nursing and Mental Health Services*, *44*(2), 17-20.

Mueller, D. P. (1980). Social network: A promising direction for research on the relationship of the social environment to psychiatric disorder. Soc. Sci. Med. 40: 147-161.

Shulman, S., Davila, J., & Shachar-Shapira, L. (2011). Assessing romantic competence among older adolescents. *Journal of Adolescence*, *34*(3), 397-406. doi:10.1016/j.adolescence.2010.08.002

Simpson JA, Collins WA, Tran S, Haydon KC. 2007. Attachment and the experience and expression of emotions in romantic relationships: a developmental perspective. J. Personal. Soc. Psychol.72:355–67

Smetana, J. G., Campione-Barr, N., & Metzger, A. (2006). Adolescent development in interpersonal and societal contexts. *Annual Review of Psychology*, *57*(1), 255-284. doi:10.1146/annurev.psych.57.102904.190124

Wierson, M., Forehand, R., & McCombs, A. (1988). The relationship of early adolescent functioning to parent-reported and adolescent-perceived interparental conflict. *Journal of Abnormal Child Psychology*, *16*(6), 707-718.

An Analysis of the Self-Identification of Algerian Novelists Mouloud Feraoun and Yasmina Khadra and their French Education

Brooke Durham, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Janina Safran, Ph.D
Associate Professor of History
Department of History
College of the Liberal Arts
The Pennsylvania State University

Abstract

From 1830 to 1962, the French maintained an Algerian colony; they educated the Algerian young, inculcating French values, literature, and history into their hearts and minds. This *mission civilisatrice* provides the context in which this project analyzes the Franco-Algerian fictional and autobiographical works of Mouloud Feraoun and Mohammed Moulessehoul--alias, Yasmina Khadra. Both authors, representing different regions and generations of Algeria, write of divided selves, and, in doing so, define themselves first and foremost as writers. This analysis of the authors' self-representations offers an interdisciplinary contribution to researchers interested in the psycho-social consequences of colonial rule and its remnants.

Introduction

French colonization of Algeria, from 1830 to 1962, lasted for over a century until an Algerian nationalist movement violently realized its demand for the independence of Algeria. Support for revolution was not unanimous, but was at the center of Algerian identity-formation. A story Frantz Fanon tells of a young Algerian man's psychological state in this period illustrates the subsequent war's impact on individual subjectivity.[1] This young man was not invested in the nationalist movement because he was preoccupied with fulfilling his career objective of becoming a specialist in multicopying-machines. As the war progressed, the young man began to hear voices calling him a coward and a traitor, which scared him so much that he locked himself in his room and refused to come out.

[1] In this study, I will refrain from using the terms "native" and "indigenous" to describe the non-European Algerian population. I find these terms to carry a negative connotation. If these words are present in this paper, they will be in quotation marks or figure in citations. The term "colonized" will be used to speak of the Algerian population under the French colonial regime, and the term "colonizer" refers to the French and other European settlers in Algeria prior to independence. I will use the term "Algerian" to refer to the non-European population living in Algeria prior to, during, and after the Algerian war for independence; I will use this term loosely as I include Arabs, Berbers, Kabyles, and other ethnic, non-European groups. Additionally, the term "savage war" for describing the Algerian struggle for independence will not be used. Though the war was extremely violent and used non-orthodox war tactics on both sides, I will not refer to the war in this manner. I will also use the term *colons* to refer to the French settlers and their descendants in Algeria.

One day, however, he ventured into a European part of town, stumbling around like a madman. The young man, suffering from guilt resulting from years of complacency toward his people's nationalist goals, sought to "prove" that he was one of the oppressed. He imagined that if he was apprehended by the authorities, he would demonstrate some commitment to the revolutionary cause. Surprisingly, he was not stopped by the colonial police or by the French soldiers to be searched or questioned. The disturbed young man became furious because, for him, the authorities' lack of action signified his non-Algerian-ness. Since the patrols continued to ignore him, the man came to believe that everyone knew that he was "with the French." As he attempted to wrestle a machine gun away from a soldier, he felt the contemptuous glances of humiliated Algerians undergoing police persecution. Deranged and furious over his imagined association with the occupying power, he yelled, "I am an Algerian!" This proud proclamation of identity sealed by the weight of the gun, triggered the desired response. The young man was captured by the French army and questioned. However, the soldiers quickly concluded that the young man was mentally ill and delivered him to the hospital.[2]

During the Algerian War for independence from France, not all Algerians participated in the nationalist movement, but did this mean that they were not truly Algerian and that they were "with the French"? In the above example, the young man assumes that his compatriots call him a coward and a traitor and place him "with the French" because of his devotion to his studies and his ambitions to have a profession and he feels ashamed. He also assumes that because he is ignored by the French police and military that he has been "accepted" or exempted from the way these foreign forces typically treated the non-European Algerians, and this also shames him. Striving to make something of oneself through colonial education leads to an acquisition of and appreciation for the colonizer's culture. An identity conundrum arises when the Algerian educated individual struggles to reconcile his or her ethnic identity with his or her learned "French" identity while not wanting to be identified as a traitor or "with the French" by his or her people. This uncomfortable combination of identities and loyalties are the subject of this study; during and following the Algerian struggle for independence, many Algerians questioned their identity, where did they fit in? Why? The novels and autobiographical works written by Algerian intellectuals offer a rich site for investigating Algerians' experience with identity conflict. Throughout this study, I will examine how Algerian-ness is named, proclaimed, and interrogated.

Frantz Fanon

This study draws from the works of Frantz Fanon to frame the argument concerning the effects of the colonial system on the colonized people. Fanon writes about the "native intellectual" as well as the "native writer" which are the relevant subgroups for this study. Martinique-born, Frantz Fanon was a psychiatrist, philosopher, writer, and revolutionary. Serving as the head of the psychiatry department at Blida-Joinville Psychiatric Hospital from 1953 to 1956, Fanon was able to observe and treat patients such as the troubled young man aforementioned as well as Algerian and French victims of torture. As a psychiatrist, Fanon witnessed the psychological effects of colonialism first-hand when the war first broke out in 1954.

[2] Fanon, F. (1968). *The Wretched of the Earth* (pp. 272-275). New York, NY: Grove Press Inc.

In reference to the nationalistic culture of the Algerian struggle for independence, Fanon asks if there is a "suspension of culture" during the conflict or if the national struggle is an "expression of a culture." He answers his own questions: "We believe that the conscious and organized undertaking by a colonized people to re-establish the sovereignty of the nation constitutes the most complete and obvious cultural manifestation that exists."[3] In Fanon's view, the frantic attitude of the young man in the opening paragraph indicates a disorientation due to non-engagement in the nationalist movement: By not getting involved the young man had cut himself off from the emergent national culture. So, who is he? To what culture does he belong if not to that of his ancestors? To that of the French?

Fanon describes the attitudes of the *colons* or the Europeans who came to settle in colonial states and their progeny. According to Fanon, this Western bourgeoisie need not fear the competition of "those whom it exploits and holds in contempt;" European prejudice as regards the colonized people is "a racism of contempt; it is a racism that minimizes what it hates."[4] Even though they are rejected by the colonizer, Fanon argues that the "native intellectual" who still attempts to belong to the colonizer's culture or tries to adhere to both the cultures of the colonizer and that of the emergent nation will choose to abandon one of the cultures:

> It will also be quite normal to hear certain natives to declare…'I speak as an Algerian and as a Frenchman…' The intellectual who is Arab and French or Nigerian and English, when he comes up against the need to take on two nationalities, chooses, if he wants to remain true to himself, the negation of one of these determinations.[5]

The colonizer's insistence on the colonized people's dependence upon them exacerbates this impossibility of complete assimilation into the culture of the colonizer. The objective of colonization was to persuade the colonized people that the occupying power came to "lighten their darkness;" the colonizers sought to convince the native population that if the settlers were to leave, they would return to "barbarism, degradation, and bestiality."[6] Fanon argued that colonialism is violence—physical and mental— "in its natural state," and the only way out to escape the oppressive colonial system was through a violent uprising by the native population.[7]

Albert Memmi

This study is further contextualized through the work of Albert Memmi who expressed arguments concerning the colonized intellectual and the colonized writer similar to Fanon's in his book, *The Colonizer and the Colonized*. In this book, Memmi offered a critique of colonialism as a "social relation and psychological drama."[8] Memmi's work derived its authority from the author's own experience as a Jewish, French-speaking, Tunisian of Berber ancestry, which placed him in a unique societal position because he was among the colonized but treated differently.

---

[3] Fanon, *Wretched*, 245
[4] Ibid.163
[5] Ibid. 218
[6] Ibid. 210-211
[7] Ibid. 61
[8] Wainwright, J. (2005). Book Review: The Colonizer and the Colonized. *Progress in Human Geography, 29*, p.532.

Memmi wrote about the effect of colonialism on the colonized, including depersonalization and dehumanization. Like Fanon, Memmi believed that the problems of the colonized could not be changed within the colonial relationship and argued that the only way to end the colonial domination was through revolt. Memmi came to this conclusion after explaining the impossibility of assimilation in the face of colonial racism. According to Memmi, those colonized people who seek assimilation typically grow tired of the "exorbitant price" they must pay and which they "never finish owing." The price is twofold: the alienation of the French-educated from their own people and the rejection by the French themselves. Describing the alienation of the intellectual, he writes, "it is a dramatic moment when he [the intellectual] realizes that he has assumed all the accusations and condemnations of the colonizer, that he is becoming accustomed to looking at his own people through the eyes of their procurer." Assimilation is impossible because "everything is mobilized so that the colonized cannot cross the doorstep" into equality with the colonizer.[9]

Fanon and Memmi both describe the impossibility of assimilation as a structural problem—colonization cannot exist without the exploitation of the colonized—but are also attuned to the power of the colonized people's desire to assimilate. Fanon writes that the colonized greedily try to make European culture their own, like adopted children:

> [The native intellectual] throws himself in frenzied fashion into the frantic acquisition of the culture of the occupying power and takes every opportunity of unfavorably criticizing his own national culture, or else takes refuge in setting out and substantiating the claims of that culture in a way that is passionate but rapidly becomes unproductive.[10]

According to Fanon, no matter how much European education the "native middle class" acquires, they will always fail to replicate the Europeans and remain caricatures of the occupying power.[11]Fanon and Memmi want the colonized people to understand that since complete assimilation will never occur, the only escape from the oppressive colonial system is through violence and revolt. They locate the individual within the system and associate the resolution of the individual's identity problems with the end of colonization.

However, identity was a complicated, personal matter that the colonized people had to come to terms with, before and during decolonization. The "native intellectual" was in a unique situation because he or she had been successful in getting as close to the colonizer as possible, most commonly through success in the colonial education system. In the case of Algeria, which is the focus of this study, Algerian intellectuals struggled to reconcile their Algerian nationality—which complicated identity further because one could argue that the Algerian nation did not exist until the Revolution—with their ethnic identity (i.e. Berber, Kabyle) and both of those compounded with their Francophone identity which was inculcated in them as children in school where they were taught French grammar and French history. This study will seek to answer the following questions: How did Algerian intellectuals cope with receiving a French education and desiring and fighting for an independent Algeria? How did (and do) Algerian novelists see themselves? How did they interpret their role in the context of the fight for Algerian

---

[9] Memmi, A. (1965). *The Colonizer and the Colonizer* (pp. 123, 125). Boston, MA: Beacon Press.
[10] Fanon, *Wretched*, 218, 237
[11] Ibid. 175

independence? What did (and does) it mean to be Algerian? Is the native intellectual simply stuck "entre-deux"—between two different cultures?

Mission civilisatrice, Assimilation vs. Association

Before beginning an analysis of the selected authors and their works, a quick clarification of the terms "assimilation" and "association" as used in the French colonial context is in order. According to Elsa M. Harik, the most common meaning of assimilation "stemmed from the tendency of French culture, with roots in both Revolutionary and Romantic thought, to see things in terms of universals, truths applicable for the good of all humanity." The desire to make the conquered people of Algeria Frenchmen—"or at least to strive for a close harmony of races within the embrace of France civilization"—was the original goal of the French settlers in the first few years of Algerian occupation.[12] This mindset draws attention to the idea that the "indigenous culture could be ignored or even suppressed;" Fanon also points to this minimizing of the colonized people's culture in favor of the occupiers culture. For him, it is through culture that a nation expresses itself; in the colonial situation, "culture, which is doubly deprived of the support of the nation and of the state, falls away and dies."[13]

Around the turn of the nineteenth century, the assimilationist attitude of the European settlers would die out in favor of "association." Association "called for a more flexible, practical policy, recognition of differences among peoples, respect for indigenous customs;" in short, association sought to achieve a cooperative partnership between the colonizer and the colonized based on fraternity and mutual interests—but not based on equality.[14] Although Mouloud Feraoun and Yasmina Khadra grew up and wrote after the *colons'* policy shifted to association, the gap between the promises of French education and French cultural values and the Algerian reality loomed as large if not larger once inequality became "official."

When the *colons* talked about assimilation, "they were demanding political and administrative assimilation with France. This included the full benefits of French citizenship and the installation of French political institutions in the colony—basically the *colons* wanted an end to the military rule in the colony which obstructed their claim for unimpeded access to the land. Around 1900, the *colons* rejected *this* form of assimilation and "demanded as much independence of action [in the colony] as possible."[15]

Thus, there are two different instances of assimilation. One involved the suppression of the Algerian culture in order to assimilate the Algerian people to French culture during the first few years of the French occupation of Algeria. The second assimilation describes the attitude of the *colons* who wanted to assimilate to the French administration of the *métropole* so that they could enjoy the full benefits of French citizenship and French institutions. Both of these assimilations were abandoned in the 1900s. The first was to be replaced with "association" and the second was dismissed when the *colons* decided that independence from the French

[12]H arik, E., & Marston, D. (1984). *The Politics of Education in Colonial Algeria* (p. 10). Athens, OH: Ohio University, Center for International Studies.
[13] Fanon, *Wretched*, 244
[14] Harik & Marston, *The Politics of Education*, 10
[15] Ibid.

administration would better serve their interests in Algeria. The differences between the two "assimilations" may cause confusion; for this reason, "assimilation" as used in this study refers to the first assimilation—that of the Algerians' culture being replaced with that of the French occupiers.

Purpose of Study

This study seeks to analyze the self-identification struggle of two Algerian authors through their novels and autobiographical works: Mouloud Feraoun and Mohamed Moulessehoul (Yasmina Khadra).[16] This study will not assess these authors' identities based on what others have said—scholarly claims or otherwise—but rather seeks to examine what the authors have said about themselves or what can be inferred about the authors' struggle for identity from the characters in their novels. This study will not address the politics of Algerian identity in the context of the Algerian War for independence; this study seeks to simply analyze the authors' self-assessment of their identity struggle as evidenced in their works. Using the writings of Frantz Fanon and Albert Memmi mentioned above, this study will operate within the colonial framework these two authors describe: The impossible situation of the colonized who achieves a French education and immersion in French culture but who is not accepted as French and does not see himself as French. These Francophone Algerian writers use writing to define themselves as not between two chairs, to orient themselves in place and culture, to make something possible out of the impossible. They recognize the constraints on their self-realization, as described by Fanon and Memmi, but also reject the "impossibility" of their situation. In a way, they carve out a third identity: "intellectual" or "writer."

Mouloud Feraoun and Yasmina Khadra were both educated in French at a young age. Not only were these authors exposed to the French education system, but they were also able to succeed within it: Feraoun would go on to become a French schoolteacher and Khadra was successful in his schooling in the post-independence military academies. Both authors mention their educational experiences in their novels and autobiographical works; thus, it is easy to conclude that their Western education had a profound impact on them as young children and during their adult life.

The French Colonial Education System

Pre-colonization Education

In order to analyze the impact of French colonial education on Feraoun and Khadra, the French colonial education system itself must be explored. Prior to the French invasion of Algeria in 1830, only primary and secondary education was available in Algeria.[17] Arabic reading, writing, and the memorization of Qur'anic verses made up the simple Algerian primary school

[16] In the rest of the paper, I will refer to Moulessehoul by his pen name, Yasmina Khadra and the singular masculine personal pronoun.
[17] Heggoy, A. A. (1975). Arab Education in Colonial Algeria. *Journal of African Studies*, *2*(2),149.

curriculum.[18]The next level of education was a type of middle school located either in mosques or in *zawiyah*—the headquarters of religious brotherhoods; here students continued to improve their Arabic reading skills with supplementary courses in Qur'anic commentary and in elementary grammar. The superior level of education—referred to as "secondary" education in Algeria—also operated out of the mosques or independent quarters known as the *madrasah*; the curriculum for a wide age spectrum of young Algerians featured classes on law, jurisprudence, theology and the best *madaris* taught arithmetic, astronomy, geography, history, and, sometimes natural history and medicine. The Algerian state was not directly involved in education and it was more available in the cities than in rural tribal areas. All levels of education were free, paid for by pious donations or donations of property.[19]

Education during Occupation

When France conquered Algeria in 1830, the colonial administration promised not to interfere with Islam—the religion of almost all Algerians—or to attack personal status as defined in Muslim law. Thus, French officials ignored the activities of the Qur'anic schools and the *madaris*, but managed to indirectly undermine the existing free-school system by offering a French alternative.[20] By 1883, the French colonial government imposed the same education system that existed in metropolitan France in Algeria.[21] In 1895, the teaching of both Arabic and French was strengthened in French-sponsored *madaris*; the colonial government sought to create schools for advanced Muslim studies under French guidance.[22] Despite this aspiration, French efforts to educate Algerian children were limited in scope; for instance, there were only 33,000 young Muslims in official schools in 1907 out of close to 1.75 million children in Algeria. It was not until 1917, that primary education was made compulsory for boys, but this decree could not be enforced because there were not enough schools or trained teachers to accommodate them.[23] In the following decade—the 1920s—Mouloud Feraoun began his colonial primary schooling in the Kabylia region of Algeria.

Returning Algerian migrant workers from France—having witnessed first-hand the benefits of a French education—began to pressure the colonial government in the 1930s for more and better public education opportunities for their children. As a result of this lobbying, the French redoubled their efforts to turn their Algerian subjects into Frenchmen—which contributed to their supposed commitment to assimilation. However, the enormous cost of building schools and training enough teachers in conjunction with the deep distrust Algerians felt toward all French institutions presented obstacles to this expansion of education and compulsory primary education for all Algerian children seemed unrealizable.[24]

---

[18] Heggoy, Arab Education, 149
[19] Ibid.
[20] Ibid. 150-151
[21] Colonna, F. (2008). Training the National Elites in Colonial Algeria 1920-1954. *Historical Social Research*, *33*(2), 285
[22] Heggoy, Arab Education, 151
[23] Heggoy, A.A. (1973a). Education in French Algeria: An Essay on Cultural Conflict. *Comparative Education Review*, *17*(2), 185-186.
[24] Ibid. 186.

The colonial school system trained Algerian teachers to teach in the French schools alongside European teachers. Fanny Colonna argues that one of the main objectives of the French in training native Algerian teachers—like Feraoun— was to create cultural mediators who would be put in charge of spreading French culture.[25] While the French built new schools to teach French literature, history, and culture, Islamic schools struggled to continue to attract a significant number of students and to retain funding for their education programs. This conflict between French public schools and traditional Arab schools occurred against the backdrop of the larger issue of Arabic being recognized by the French government as an official language in colonial Algeria. When the French took over the administration of Algeria, Arabic lost its official language status and French became the sole official language in colonial Algeria. The Arabic language would not be given official status until 1947 following World War II as a reward to the Algerians for the their participation in the French forces[26] In Colonna's view, the colonial school system structured society beyond the colonial period: "Arab speakers were and are still today in an inferior, dominated position." She concluded that the colonial system is not a "dichotomy, it's not [two] worlds that ignore each other but on the contrary, worlds which observe each other with envy (but the envy only goes one way.)"[27]

Colonial Education as a Counterinsurgency Tactic

During the Algerian War for Independence (1954-1962), the French military became involved with colonial education because it saw that it could be used as a counterinsurgency program. The French military had an interest in bettering the lives of the Algerian people in order to discourage them from joining the revolutionary movement. Additionally, education provided a context in which the French could continue their "civilizing" mission and instill French values in the native Algerians which the French hoped would foster loyalty to the colonial regime. Counterinsurgency education programs fostered personal contact between the French administration and the Algerian people; this contact enabled the French military to gather the intelligence information they desperately needed to combat the Algerian rebels during the Algerian war.[28]

The French military developed programs such as the Special Administrative Services (SAS), the *Service de Formation des Jeunes en Algérie*, the *Centres Sociaux*, the *Formation Professionelle Accélérée*, and the *Formation Professionelle des Adultes*; these programs focused on improving and expanding primary, vocational and technical education. Despite the valiant effort on behalf of the French to rehabilitate the education system and offer better opportunities for the Algerian children and adults—while also serving their own "civilizing" and militaristic goals for the colony—many Algerians remained unaffected by these programs. It proved difficult for the basic education programs to keep up financially with an annual population increase of 2.85%. When gathering intelligence through the families encountered through these educational programs, the military would often resort to torture or other violent means to extract information

[25] Colonna, Training the National Elites, 289.
[26] Heggoy, Arab Education , 151-152
[27] Colonna, Training the National Elites, 288.
[28] Heggoy, A. A. (1973b, December). Kepi and Chalkboards: French Soldiers and Education in Revolutionary Algeria. *Military Affairs, 37*(4),141-142.

about the Algerian rebel cause. This brutality shed light on the superficiality of the perceived benevolence of these military-sponsored educational services and contributed to the French military's failure to deter Algerians from joining the resistance movement. The Algerian *Front de Libération Nationale* (FLN) was suspicious of these educational programs, and began to see the officers of the SAS in particular as their most dangerous enemies.[29] It is interesting to note that while Feraoun seemed "to trust the aims of the *Centres Sociaux*, he openly distrusted the role of the SAS in the Algerian conflict and comments on it frequently" in *Journal 1955-1962: Reflections on the French-Algerian War*. Feraoun himself joined the *Centres Sociaux* in October 1960.[30] In conclusion, these education initiatives by the French military were not as influential or far-reaching as they could have been, except for the SAS which was one of the programs that was successful and could have seen a greater level of success if other activities—such as the gathering of intelligence through the use of torture—had not undermined its progress.[31]

Selected Authors and their Education

How did the colonial education system affect the Algerian people and the authors selected? Mouloud Feraoun (1913-1962) and Yasmina Khadra (1955-) both received a French education in Algeria. Feraoun was chosen for this study because he wrote before and during the war for independence. He was a man from the Kabylia region of Algeria. Khadra was chosen because he wrote after the war for independence in which his father was a military hero. He was from the western Sahara desert region of Algeria and he spent many years in the Algerian army writing behind a female name. He duped his audience into thinking that they were appreciating a female's point of view on the Muslim world when in reality they were reading the words of an Algerian major.

Both of these authors wrote in French. Their use of the language of the colonizer as well as their use of the French form of writing—autobiographies and novels—further complicated identifying them in one way versus another. The encyclopedia entry for Feraoun in the 1983 Grand Larousse Universel read, "Algerian writer of the French language (Tizi-Hibel, Grande Kabylie, 1913- El-Biar, 1962)."[32] That entry was ambiguous; what did it mean to be an Algerian writer of the French language from Kabylia? Ties to Algeria, France, and Kabylia all at once made self-identification difficult for Feraoun during his lifetime. Compound this complex background with a French education and internal confusion was inevitable. Feraoun and Khadra explored and expressed their identity in their novels and autobiographies. The purpose of this paper is to study these authors' self-identification as evidenced by their written works.

[29] Heggoy, Kepi and Chalkboards, 141-144.
[30] Le Sueur, J.D. (2000). Introduction. In M. Feraoun, *Journal, 1955-1962: Reflections on the French-Algerian War* (pp. xviii). Lincoln, NE: University of Nebraska Press.
[31] Heggoy, Kepi and Chalkboards, 144.
[32] Thenault, S. (1999, July). Mouloud Feraoun. Un écrivain dans la guerre d'Algérie. *Vingtième Siècle. Revue d'histoire, 63,* 65. (my translation).

Methodology

This study is informed by the Postcolonial approach. Postcolonial studies examine the effects of colonization on the organization of political, social, and economic life and on culture. Postcolonial studies interrogate the colonial relationship and demonstrate how influence is not unidirectional and culture generated by the encounter between colonizer and colonized is hybridic. The writers with a French education are not passive recipients of that education but use it to express themselves as colonized and as Algerians. One of the many objectives of Postcolonial studies is to draw attention to a "necessary shift in emphasis, a strategy of reading, an attempt to point out what was missing in previous analyses, and an attempt to rewrite and to correct." Building on the ideas of Fanon and Memmi, postcolonial studies demonstrate that the Western paradigm—Manichean (good vs. evil) and binary—is highly problematical.[33]

The significance of this study is in drawing attention back to the individual from the colonial framework and its legacy. The study looks at what the authors within the colonial system and after it write about themselves instead of generalizing about a group of "native intellectuals". Fanon and Memmi make strong arguments about the impossibility of the "French Algerian" but Feraoun and Khadra argue differently. In this study, I will analyze how Mouloud Feraoun and Yasmina Khadra experienced and wrote about conflicts of identity.

I have chosen to read a memoir and a novel by each author because each literary genre allows for the exploration of subjective experience in different ways. The memoir or autobiography presents a more consciously crafted self while a novel allows for the fictionalization of the self and the development of themes among multiple characters. By Mouloud Feraoun, I have chosen to read *Le Fils du pauvre* (*The Poor Man's Son: Menrad, Kabyle Schoolteacher*) and *Journal 1955-1962* (*Journal 1955-1962: Reflections on the French-Algerian War*). I chose to read *Le Fils du pauvre* because it is considered an autobiographical novel in that the protagonist's name is Menrad Fouroulou which is an anagram of Mouloud Feraoun. Fouroulou's coming of age story and family life mirrors Feraoun's own life story, and, thus, reveals useful information relevant to the author's identity struggles throughout his life. *Journal 1955-1962* is Feraoun's almost daily journal which chronicles the Algerian War. Feraoun's personal writing offers insightful information on his daily life as well as fascinating introspection on what the war meant for him and where he placed himself in the conflict between the French and the nationalist Algerians.

The two books by Yasmina Khadra that I have chosen to read for this study are *L'Écrivain* (*The Writer*) and *Ce que le jour doit à la nuit* (*What the Day Owes the Night*). *L'Écrivain* tells the autobiographical story of Khadra's upbringing and the beginnings of his military career in the military academies he attended as a young boy and as a young adult. The story centers around his education in the academies and his self-definition as a writer as evidenced by the title of his autobiography. Thus, this work is a rich source of information regarding Khadra's identity struggles growing up in post-colonial Algeria. *Ce que le jour doit à la nuit* (What the Day Owes the Night) is a novel that tells the story of Younes, a poor boy from

[33] Groden, M., Kreiswirth, M., & Szeman, I. (Eds.). (2005). Postcolonial Cultural Studies: 1. Origins to the 1980s. In *The Johns Hopkins Guide to Literary Theory and Criticism* (2nd ed.). Baltimore, MD: Johns Hopkins University Press. Retrieved July 9, 2013, from Johns Hopkins Guide to Literary Theory and Criticism.

the Algerian countryside who comes to live with his uncle and his French wife in the European part of Oran and Río Salado in Algeria. Renamed "Jonas" and educated in a French school, the young boy's self-identification evolves throughout the novel as he experiences pre-independence, wartime, and post-war Algeria. This first-person narrative offers valuable insight into the personal, unique experience of the protagonist concerning his internal identity strife during a historically difficult period. The personal identity crisis of Younes/Jonas reflects Khadra's opinion of internal battles concerning identity.

All of these novels were originally published in French. This study is limited to an analysis of the English translations of *Le Fils du pauvre* and *Journal 1955-1962*. *L'Écrivain* and *Ce que le jour doit à la nuit* will be analyzed in their original French versions.

Mouloud Feraoun

According to Monique Gadant-Benzine, it still common today, upon the mention of Mouloud Feraoun to hear people say, "'Feraoun? C'était un Français!'" ("He was a Frenchman!").[34]Mouloud Feraoun was born on March 8th, 1913 in Tizi-Hibel in the Kabyle region of Algeria to a family of poor *fellahs* (peasants) with eight children of whom five survived. Mouloud was the third child and the first boy. Since 1910, the father of Feraoun's family habitually traveled to France to work and provide for his family until 1928, when he was injured in an accident and, as a result, received enough financial compensation to eliminate the need to continue to travel to France. Feraoun won a scholarship to attend *6e* at the *Collège de Tizi-Ouzou*. In 1932, at the age of 19 years old, Feraoun entered *l'École normale d'instituteurs* in Bouzaréa, on the outskirts of Algiers where he received the necessary training to become a schoolteacher.[35] After *l'École*, Feraoun was assigned to teach in Kabylia and eventually served as a principal; he married his cousin, according to Kabyle custom, with whom he would have seven children.[36] Feraoun did not leave Kabylia until 1957 when he became an inspector and co-director at the *Centres de Services Sociaux Éducatifs* at Château Royal near Algiers.[37] He was assassinated on March 15th, 1962 by French terrorists in the *Organization de l'armée secrete* (OAS).

Feraoun initiated another career in addition to his civil service career when he began a manuscript in 1939 that became *Le Fils du pauvre* (*The Poor Man's Son*). Over twelve years, Feraoun worked on this manuscript during the night, writing in school notebooks. *Le Fils du pauvre* is an exercise in "auto-fiction" and won Feraoun the Grand Prize of the City of Algiers—the first time this prize was awarded to a non-European Algerian. "In a writing style that was more concerned with a heartfelt layering of personal and collective observation than with literary esthetics," according to Lucy McNair, "Feraoun's novels were written and presented by himself as historical testimony: they provided internal witness to the abject yet ignored misery of Colonial Algeria."[38] McNair provides a useful literary historical context for interpreting the

[34] Gadant-Benzine, M. (1978, July). Mouloud Feraoun, un Algérien ambigu.? *Peuples Méditerranéens*, *4*, 3.
[35] Thenault, Mouloud Feraoun, 66.
[36] Ibid.; McNair, L. R. (2006, August). An Algerian-American Primer: Reading Mouloud Feraoun's The Poor Man's Son. Menrad, Kabyle Schoolteacher. *Contemporary French and Francophone Studies*, *10*(2), 189.
[37] McNair, An Algerian-American Primer, 189
[38] Ibid.

novel as a direct response to the *École d'Algers*—European-Algerian writers like Albert Camus and Emmanuel Roblès. Even though these writers "broke taboos by exposing the brutality of colonial life in opposition to the exotic travel journals French audiences were accustomed to reading," "native Algerians" were left out of their texts. For Feraoun, this absence of non-European Algerians in these novels shed light on the sad truth of the "brutal, ingrained indifference and ignorance between the Algerians and the European *colons*;" Feraoun also interpreted this absence as an invitation for individuals—like himself—who managed to overcome their ethnic identities enough to imagine a common reality for both sides. For McNair, Feraoun's books "exhibited a pan-Algerian modesty, a hesitancy to speak about anything not personally lived;" in this way, the writer's function is to observe, speak as a witness, and bring to light the truth.[39]

McNair addresses two criticisms of Feraoun's writings: that he used the language of the colonizer and that his style of "folkloric realism" did not address the harsh realities of colonial rule. She suggests that Feraoun, who belonged to the first generation of non-European Algerians capable of mastering written French, wrote in French as "the language of universal values, of human rights, of political and individual freedom." The "folkloric realism" of the novel takes up the oral models of his ancestors and contributes to Feraoun's aspirations to put Kabylia and his people on the world map, thus restoring a historical omission.[40]

Le Fils du pauvre (*The Poor Man's Son*)

Initially self-published, *Le Fils du pauvre* was reissued by Éditions du Seuil in 1954. The English translation is divided into two parts and documents the daily life of an individual in a poor, rural, traditional Berber community in Algeria in the 1920s and 30s; the story traces the introduction of the main character—Menrad Fouroulou—into the larger context of the colonial world.[41] The main character's name—Menrad Fouroulou—is an anagram of Mouloud Feraoun and the first edition of *Le Fils du pauvre* was dedicated to Feraoun's beloved professors, "a mes maîtres vénérés."[42]

It is significant to note that before the French Éditions du Seuil published *Le Fils du pauvre*, editors asked Feraoun to remove the parts of his narrative concerning his time at *L'École normale d'instituteurs*, his first few years as a teacher in Kabylia, and the entire second part of the book which discussed the Algerians' situation during and following World War II.[43] This cut is significant because it is in these sections of the book that Feraoun harshly discusses his frustration with France—the Vichy regime, the Gaulists, and the "roumis" or small-town French settlers. These pages contain Feraoun's assessment of the intersections and dislocations between the French and the Algerian cultures. The second edition of the novel ends with Fouroulou—too old to enter the *L'École normale d'instituteurs*—instead contemplating going to Algiers to find

[39] McNair, An Algerian-American Primer, 189-190.
[40] Ibid. 190
[41] McNair, L.R. (2005). Introduction. In M. Feraoun, *The Poor Man's Son* (pp. 2). Charlottesville, VA: University of Virginia Press.
[42] Adam, J. (1981, November). Les débuts littéraires de Mouloud Feraoun: de "Menrad Fouroulou" au "Fils du pauvre". *Revue d'Histoire littéraire de la France, 6*. 945
[43] Ibid. 951-952

work.[44] Thus, the second edition carved out Feraoun's criticisms of the French during and following World War II to produce a tale with a more manageable ending for European audiences.

Le Fils du pauvre is a coming of age story and the voice of the narrator changes in its different sections from intimate to more formal, thus broadening the focus of the novel from the life of an individual to the portrait of a people.[45] In the first part of the novel, the personal pronouns "I," "my," "me" provide the intimacy appropriate for the narrator's introduction of Fouroulou's family life and his early experiences in school and in his village. The narrator shifts in the second part of the book to the third person, "Fouroulou," "he," and "his," and in this section, the hero lives away from home while attending the *École Primaire Supérieure*. The main character has grown up, and he is motivated to study to ensure his success alongside his more affluent classmates; more importantly, he dreams of becoming a teacher. Finally, in the third part of the book, the focus is not so much Fourourlou's life, but more so that of his fellow Kabyles; thus, a universal narrator, aware of the broader issues beyond Fouroulou's life takes over. Fouroulolu's experience is still emphasized and serves as a lens through which the reader can acknowledge the suffering of his fellow countrymen. Dalila Belkacem notes that the preface of the second part of the novel, "Le Fils aîné," introduces a narrator who is an unnamed, close friend of Fouroulou: "Fouroulou is passing the pen to a friend…whether out of modesty or out of bashful timidity… [Fouroulou,] you want the narrator to be quiet. No, let him be. He likes you well. He'll tell your story."[46]

This shift between narrators in *Le Fils du pauvre* allows Feraoun to back away from his personal story and present a more complete portrait of his people; the transition between different narrators points to the ambiguous genre of the book itself. Feraoun began writing *Le Fils du pauvre* in 1939 and finished the book in three years from 1945 to 1948. I think that the time Feraoun spent away from writing refined his idea for the novel; at first purely autobiographical, Feraoun later decided to widen the scope of Fourourlou's story and, consequently, turned it into a "novel." The effects of World War II, I believe, inspired Feraoun to record the second half of Fouroulou's life alongside the difficulties that befell all of Kabylia (this is the part Éditions du Seuil cut from their edition). In Belkacem's view, the transition to the third person narrator separates the autobiographical part of Feraoun's work from the "novel" part of the book.[47] Although the book never stops telling the story of Fouroulou/Feraoun, this shift in the narrator calls into question the "true" genre of the book.

Feraoun reconciled the personal nature of autobiographical writing with conventions of privacy—"on garde sa vie pour soi" ("we keep our lives to ourselves")—by attributing his own life story to a character, Menrad Fouroulou, and by shifting from the first person to the third person he makes the reader aware of this construct.[48] The book, "entre-deux," is a cross between autobiography and novel, and a bridge between North African and European cultures. Just as his

---

[44] LeSueur, J.D. (2005). Introduction. In M. Feraoun. *The Poor Man's Son, Menrad, Kabyle Schoolteacher* (pp.xii). Charlottesville, VA: University of Virginia Press.
[45] In this paragraph, I am referencing this English translation of the novel Feraoun, M. (2005). *The Poor Man's Son: Menrad, Kabyle Schoolteacher*. Charlottesville, VA: University of Virginia Press.
[46] Belkacem, D. (2005). Du texte autobiographique au texte romanesque dans "Le Fils du pauvre" de Mouloud Feraoun. *Insaniyat,29-3*, 159-173 (my translation).
[47] Ibid.
[48] Ibid. (my translation)

"autobiographical novel" is not easily classified as one genre or the other, so is it difficult to classify the author as an Algerian or as a Frenchman or, more specifically, as an Algerian writer or as a French writer.

Feraoun's primary identity is Kabyle. Aware of the uniqueness of his education and achievements, Feraoun decides to describe Fouroulou—and himself—as an "every man," as a Kabyle like any other. This is another angle on his perception of himself as *évolué* while deeply connected to his native Kabylia. In the first part of the book, Fouroulou is privileged because he is the only son in his family:

> My mother, her sisters, my maternal aunts—my true aunts—adored me; my father gave in to all my wishes; my grandmother, who was the village midwife, spoiled me with all the good things given to her…my uncle, who knew the value of a man at the *djemaâ* and for whom I represented the future of the Menrads, loved me as his son… I remained the sole boy of the household. I was destined to represent the strength and the courage of the family.[49]

Cherished and protected as the only son, Fouroulou understands from a young age that he is special.

This exceptionalism continues in the second part of the novel when Fouroulou takes advantage of his privilege to continue his studies and get closer to his dream of becoming a teacher. On the night he learns that he has received the family scholarship to attend the *École Primaire Supérieure*, Fouroulou is the "hero of the evening. His sisters already look upon him with respect" and his mother "prepares supper in his honor."[50] The third part of the novel marks the end of Fouroulou's uniqueness. "The times grew difficult. Very difficult. For the Menrads and for their countrymen;" Fouroulou is only trying to survive like the rest of the Kabyles, he is no longer special.[51] Fouroulou struggles to make sure everyone in his family eats during WWII when grain supplies were blocked:

> Was it not Fouroulou who told us that couscous—barley, in other words—was the sole staple of the people here? Take barley away from a Kabyle and you sentence him to starvation. It was not taken away. It was given out at warehouses. There were warehouses all over. Even at Beni Rassi, the Menrad's *douar*.[52]

Feraoun uses this transition from "exceptional" to "common man" to prove that his successes in his studies and in his professional life do not separate him from the suffering of his people. This humility is evidence of his identity as one of the starving Kabyles even as he is aware of his exceptional circumstances. This concentration on the suffering of the Kabyles in the final part of Fouroulou's story contributes to Feraoun's goal of placing Kabylia on the world map.

Feraoun's strong connection to his ethnic identity did not stop him from including many European literary references in his autobiographical novel. According to I.C Tcheho, Feraoun

---

[49] Feraoun, M. (2005). *The Poor Man's Son: Menrad, Kabyle Schoolteacher*. (p. 17) Charlottesville, VA: University of Virginia Press.
[50] Ibid. 100
[51] Ibid. 138
[52] Ibid.

employed these literary references to demonstrate that he would produce an original work which is "immersed both in his native culture and in the foreign culture." Integrating both cultures in this manner shows the reader that it is possible for an "African writer to use models from the foreign world." In the first of the European references Tcheho identifies, Feraoun compares traditional Kabylian heroes to Ulysses, the famous hero in Greek mythology. In another instance, Fouroulou declares that "these heroes are as skinny as Don Quixote." *Le Fils du pauvre* opens with a quote ascribed to Chekhov, the Russian dramatist and short story writer of the nineteenth century. Feraoun may be drawing a comparison between himself and the Russian writer; according to Tcheho, like Chekhov, "Feraoun elaborates on his characters' helplessness in the precarious conditions which they are forced to live." Another comparison drawn in the novel, "pareil au financier de la fable" connects the novel to La Fontaine's fable entitled "Le Savetier et le financier" ("The Cobbler and the Financier"). Feraoun uses this comparison to introduce an Algerian land owner who, like La Fontaine's cobbler, has become a slave to his wealth. Feraoun introduces the second part of the novel, "Le Fils aîné," with a quotation from the French historian Michelet; Michelet's writing advocates a philosophy of "resistance to pain, of tolerance and patience" in circumstances such as those in which the non-European Algerians live. Feraoun also alludes to French writer Alphonse Daudet when Fouroulou "affirms that in the past the Kabylian land was full of 'Des héro (…) aussi fiers que Tartarin.'" ("Heroes (…) as proud as Tartarin"). Finally, Feraoun quotes his contemporary, Albert Camus, "Il y a dans les hommes plus de choses à admirer que des choses à mépriser" ("There is in man more things to admire than to despise"). For Tcheho, this citation represents a plea for a "return of confidence in man."[53]

Feraoun's novel sheds light on his mastery of French writing and literature. *Le Fils du pauvre* is his story, and it is significant that he chose to include European literary elements in his narrative. Feraoun exhibits the qualities of the *évolué* writer while telling the story of his cultural upbringing in and attachment to Kabylia. Feraoun's autobiographical work is a testament to his effort to integrate French culture with Kabyle culture.

In conclusion, I found several manifestations of Feraoun's interest in exploring identity in his first novel, *Le Fils du pauvre*. First, the ambiguous genre of the book points to multivalent perspectives on identity. This ambiguity is expressed through the shift in narrators—from first person in the opening parts of the book to the third person in the final parts of the book—which causes the genre of the book to transition from an autobiography to a novel. Though he writes an "autobiographical novel"—an occidental narrative form—Feraoun simultaneously honors his North African culture's respect of personal privacy by using the character Menrad Fouroulou to tell his story. Furthermore, Feraoun attempts to reconcile his assimilated French culture with his Kabyle upbringing by recounting his personal journey as a Kabyle while using European literary references. Mouloud Feraoun—a Kabyle educated through the French colonial education system—explores his identity and presents a hybridic resolution through the integration of cultures in the narration of *Le Fils du pauvre* and its mixed genre.

[53] Tcheho, I. C. (1982). European Literary References in Mouloud Feraoun's Le Fils du pauvre. *Revue CEFLAN*, *1*(2). 19-21

Journal 1955-1962 (Journal 1955-1962: Reflections on the French-Algerian War)

For seven of the eight years of the Algerian War, Mouloud Feraoun kept a journal of the conflict, from 1955 until his death in 1962. A valuable first-hand account of France's "bitter and long overdue withdrawal from its most prized colonial possession, Algeria," Feraoun's *Journal 1955-1962: Reflections on the French-Algerian War* manifests his desire to represent the war as he saw it, without illusions and without self-censorship. He understood that the only way to affect future generations was to honestly capture the war from the inside, from personal experience. According to James D. Le Sueur who wrote the introduction to the 2000 English translation of *Journal*, Feraoun saw the collapse of French power in Algeria and North Africa as bittersweet. He welcomed the right of the Algerians to reclaim their soil and their identity from the French occupiers; additionally, he realized that French and Algerian cultures and intellectuals were deeply intertwined and that it would take generations to untangle the knots of more than a century of colonization. Feraoun had hoped that his daily notes could instruct future generations as they labored at the painful and difficult task of reconstructing the Algerian Algeria.[54]

The war troubled and excited Feraoun as he both welcomed and feared the cultural and political destruction that the war would leave in its wake. Feraoun felt pressured to support violent revolutionary methods he did not approve of; in his opinion, the Algerian nationalists distorted the revolution and the situation to pursue their agenda. Feraoun critiqued these national leaders several times in *Journal*; these negative feelings toward the nationalist party nuanced Feraoun's view of the war, rendering it extremely complex. He frequently referred back to "the dangers of revolutionary mythology, especially the absurd notion that all remnants of colonialism, good or bad, could and should be destroyed." Though he was supportive of the rebels' actions in 1955, the following year Feraoun picked up on the development of another "authoritarian beast (perhaps as dangerous as French colonialism)" within the resistance. In particular, he found the Front de Liberation Nationale's (FLN) expectations of the civilians to be "excessive and disappointing. In Journal, Feraoun characterized the prohibitions the FLN imposed on the Algerian people—such as forced observance of Islam and tobacco and alcohol restrictions—as fanatic, racist, and authoritarian; "in a way," he writes, "this is true terrorism." However, Feraoun avoided a complete condemnation of the FLN because he recognized that the French army was also to blame for the violence of the resistance movement and that brutality is generally a part of wartime dynamics.[55]

Feraoun agreed with Frantz Fanon that violence was a legitimate reaction against the French occupation and military violence but not unconditionally – the end did not necessarily justify the means. Feraoun was concerned about the effects of prolonged and devastating violence on post-war society; it is important to remember that Feraoun was himself a victim of the war's extreme brutality. Feraoun's fear of a "new 'colonization'" by Algeria's FLN leadership also contrasts with Fanon's optimistic view of the outcome of violence directed against oppression.[56] Although a practicing Muslim, Feraoun found it difficult to accept the extreme religiosity of the FLN, especially their combination of patriotism and Islam. An entry in *Journal* reads, "And so the people of Tizi-Hibel [his hometown], once the most villainous on the

[54] Le Sueur, Introduction. In M. Feraoun, *Journal, 1955-1962*, ix, xi
[55] Ibid. xxvi-xxvii
[56] Ibid. xxvii-xxviii

surface of the earth, have found their faith again; they are now paying the salary of the muezzin and frequent the mosque assiduously. God is great!"[57]

Feraoun also condemned the FLN's destruction of French-created schools even though he understood that the French military provoked these attacks by quartering troops in these buildings, Feraoun still saw this destruction as a waste of limited resources.[58] On January 29th, 1956 he recorded his own indignation when he heard that the resistance had burned down his childhood school in Tizi-Hibel: "I am angry at my people. I am angry at all those who did not know how to prevent this, who could not prevent it. Shame on all of us forever. Poor kids of Tizi, your parents are not worthy of you."[59]

Not only were schools lost but as Feraoun observed, a divide developed between French and "native" educators as the two sides "realize the stakes" of the war. He recorded his growing frustration with his French colleagues when they realized that their traditional, racist privileges in Algeria were losing currency."[60] Feraoun left no doubt that he wanted some form of Algerian independence, but the death of colonialism forced him to wrestle with the paradox of his own identity; in many ways, this led him to feel "'more French' than the French." Feraoun still cherished the ideas of liberty, equality, and fraternity instilled in him by his French education and was heartbroken that the French themselves had forgotten these values. His belief in these values prompted him to insist that the French recognize that the Algerians "no longer wanted to be French and had a right to reject French rule as illegitimate." Feraoun maintained that France's racist domination of the Arabs, Berbers and Muslims in Algeria for more than one hundred and thirty years had caused the French-Algerian war because the war forced the *maquis* to violently fight with any means they could against the French. Feraoun had no doubts that France and her so-called *mission civilisatrice* were morally bankrupt.[61]

The *Journal* proclaims the end of hypocrisy, the lifting of the mask, the end of the lie that oppression could continue forever without Algerian resistance. Hatred toward the Other, and crying out against the lies of the colonizer permits someone like Feraoun to situate himself against this dishonest backdrop and recover his dignity: "You can be convinced that I am just as culturally French as you. To think otherwise is disrespectful. I can renounce my culture, but do not think that I disown myself, that I will accept your superiority, your racism, your anger, your hatred, or your lies. A century of lies!"[62]

The reader gets the sense in *Journal*, that Feraoun felt like he has been thrown back on his "Algerian-ness" by a bad mother—France; but like all bad mothers, France has her admirable qualities that help justify "her children's" love for her in spite of herself. Here, I draw a parallel between a good "son" and a good student, as Feraoun can "appreciate" what mother-France "did for him" when he performed well in school and he obediently carried himself like a "good son" or a "good Frenchman." A *Journal* entry reads, "[France] has perhaps tricked us for a century to preserve her memory: the best image that our childhood could assemble of her." In another

---

[57] M. Feraoun, *Journal, 1955-1962*: *Reflections on the French-Algerian War*. Lincoln, NE: University of Nebraska Press. 68.
[58] Le Sueur, Introduction. In M. Feraoun *Journal, 1955-1962,* xxviii
[59] Feraoun, *Journal, 1955-1962,* 64
[60] Le Sueur, Introduction. In M. Feraoun, *Journal, 1955-1962,* xxxv
[61] Ibid. xxxv, xlvii
[62] Gadant-Benzine, Mouloud Feraoun, 11 (my translation).

profession of his allegiance to opposing ends of his identity, Feraoun writes in *Journal*, "Vive la France, as I have always loved her, Vive Algeria, as I had always hoped she would be!... Yes, Vive Algeria…but when she [Algeria] comes alive and lifts her head, I hope that she will remember France and all that she [Algeria] owes her [France]."[63]

Feraoun manifested his disdain for the way in which the French and European presses wrote about the Algerian situation in *Journal*; these media made it seem as though the Algerian uprising happened all of a sudden, as if a slumbering, exploited people abruptly shot awake.[64] Additionally, Feraoun resented the French efforts to prevent the Algerian question from coming to the floor of the United Nations.[65] In 1958, Feraoun expressed his hope that General Charles de Gaulle would bring closure to the war, "De Gaulle is a wise man. That is what I think."[66] However, Feraoun stopped writing *Journal* in July 1959 because he thought that the French army had won after several Kabyle villages rallied to the French side. When the European settlers organized a barricade rebellion in the streets of Algiers in January 1960, Feraoun resumed *Journal*.[67] Feraoun watched De Gaulle with admiration as he took on the stubborn settlers who remained unwilling to relinquish control of Algeria.[68]

Journal shows that Feraoun "was a man trapped by the infernal logic of colonial warfare." For Feraoun, the complexity of colonial history prevented simply breaking identity into the two camps of the colonizer and the colonized. *Journal* features Feraoun's frequent confessions of pain at his uncertain placement in the "no-man's land of colonial identity during the war."[69] He lamented:

> When I say that I am French, I give myself a label that each French person refuses me. I speak French, and I got my education in a French school. I have learned as much French as the average Frenchman. What am I then, dear God? Is it possible that as long as there are labels, there is not one for me? Which one is mine? Can somebody tell me what I am! Of course, they may want me to pretend that I am wearing a label because they pretend to believe in it. I am very sorry, but this is not enough.[70]

This quote from *Journal* presents significant evidence indicating Feraoun's identity struggles as he cried out for a "label" or for someone to ascribe one to him even though, as he wrote at the end, "they" only "pretend" to believe in these "labels." Furthermore, on March 14th, 1956 he wrote: "The French, the Kabyle, the soldier, and the *fellagha* [rebels] frighten me. I am afraid of myself. The French are inside me, and the Kabyle are inside me. I feel disgust for those who kill, not because they want to kill me, but because they have the backbone to kill."[71] These entries of Feraoun's journal show his identification with the French, the rebels and the Kabyles in different ways. His condemnations of the actions of both sides during the war point to the difficulties inherent in this mixed identity and show him to be a man of conscience.

---

[63] Gadant-Benzine, Mouloud Feraoun, 14 (my translation).
[64] Le Sueur, Introduction. In M. Feraoun, *Journal, 1955-1962,* xxxvi
[65] Ibid. xxxv
[66] Feraoun, *Journal, 1955-1962,* 250
[67] Thenault, Mouloud Feraoun, 71.
[68] Le Sueur, Introduction. In M. Feraoun, *Journal, 1955-1962,* xxxvii
[69] Ibid. xxxvii, xxxi
[70] Feraoun, *Journal, 1955-1962,* 65-66.
[71] Ibid. 90

Since Feraoun was one of the Algerians who achieved social mobility thanks to France, supporters of French Algeria assumed that he would also rally behind the European cause; this expectation figures in *Journal* as Feraoun regularly received invitations of the French military to attend official receptions.[72] Feraoun found these considerations flattering, but he believed that the Algerian nationalist side viewed him with just as much esteem, trust, and caution.[73] For Fanon and Memmi the effort to assimilate associated with French education sows seeds of rebellion. The colonized learns to value the ideals of the French Revolution but finds that in the eyes of the colonizer they do not apply to him. The unstated objective of the *mission civilisatrice* was to turn the Algerians into Frenchmen, but not "too French;" this project demanded the submission of the Algerians at the same time cultivating a frustration within them that would lead them to revolt.[74] The revolt called into question what it meant to be Algerian for a schoolteacher like Feraoun who served his people and sought to enable them to define themselves in and against the colonial context.

Feraoun asserted his right to define himself with his French education in his own way in the face of French racism and exclusionism. In response to the comments of his French-Algerian friends Emmanuel Roblès and Albert Camus concerning the FLN's brutal attacks and fascist tendencies—especially Camus' indignation toward the idea of one day entering Algeria with a foreigners' passport—Feraoun delivered a passionate cry for understanding in his *Journal* entry from February 18th, 1957:

> I understand quite well what each man is saying, but I would like them to understand me as well. I would like them to understand those of us who are so close to them and so different at the same time. I would like them to put themselves in our place. Those who told me what they really thought last week, who told me that I was not French. Those who are in charge of French sovereignty in this country have treated me as an enemy, they would like me to act as a good French patriot; not even that: they would like me to serve them just as I am, for no other reason than the gratitude for the fact that France has made a teacher, a school administrator, and a writer out of me; for the fact that France pays me a large salary that enables me to raise a large family. In simple terms, I am asked to repay a debt as if everything I do does not deserve a salary, as if this school had been built for my pleasure and filled with students to entertain me, as if my "teaching" were a generous gift that costs me only the pain of extending my hand to take it, as if this writer's talent with which I am a little infatuated were another gift, involuntary this time, but no less generous, one quite obviously destined to defend the cause of France at the expense of my own people, who may be wrong but who die and suffer the scorn and indifference of civilized countries. Quite simply, I am asked to die as a traitor in return for which I will have paid my debt…. I would like to tell Camus that he is as Algerian as I am, and that all Algerians are proud of him. I would add, though, that it was not so long ago that an Algerian Muslim had to show a passport to go to France. It is true that the Algerian Muslim has never considered himself to be a Frenchman. He has no such illusions.[75]

---

[72] Thenault, Mouloud Feraoun, 73.
[73] Ibid.
[74] Gadant-Benzine, Mouloud Feraoun, 5.
[75] Feraoun, *Journal, 1955-1962,* 185

In this passage, Feraoun clearly spoke up. The French never considered him a Frenchman before and now they expect his loyalty. Feraoun sarcastically examined how the French portray themselves as generous benefactors who gave everyone an opportunity to succeed, but had that been the case, there would have been many more Algerians like Feraoun. Though he did "owe" the French for his success he refused to pay this debt with what he saw as treason toward his compatriots.

In *Journal*'s final entries—culminating with Feraoun's final *mise-en-garde* hours before his assassination— Feraoun expressed his fatigue and bitterness toward the brutality of the war. Following the end of the 1960 settler barricade revolt, Feraoun confessed in *Journal* that the war was draining his energy; indeed, the war had a negative effect on Feraoun's zest for reflection: "as the war drummed on, his [*Journal*] entries [became] leaner and he [was] less willing to record his impressions because…'it was childish to narrate—for myself and in my own style—what the front page of the press from all sides throw at us everyday.'"[76] Furthermore, the violence and the murder of Feraoun's friends and family members by the French military took a toll on his compassion so much so that he became generally indifferent to the misery he witnessed, especially as the French escalated their modernizing educational efforts.[77] Feraoun expressed ambivalent feelings concerning his decision to serve in the *Centres Sociaux* as an administrator.[78] For the ultras—*colons* extremists—the *Centres Sociaux* could not retain its apolitical position, and they decided that the *Centres* had to be on the side of the Algerian national movement. Between 1957 and 1959, the ultras "discovered" that a handful of *Centres* members had links to the FLN which made Feraoun an easy target.[79]

Three days before the definitive Franco-Algerian cease-fire, on March 15th, 1962, Feraoun and five colleagues from the *Centres Sociaux* were marched outside and machine-gunned at the hands of a commando squad of the *Organization de l'armée secrete*—a French army-settler terrorist organization.[80] This tragic, abrupt end to *Journal* adds to the work's poignancy.[81] According to Le Sueur, the overall message of *Journal* is clear: "war is hell, even justified wars of liberation with all of their psychological, political, military, and racist repercussions."[82] Le Sueur concludes his "Introduction" to the 2000 translation of *Journal* by qualifying Feraoun as a "realist, an insider, and teacher" whose identity became increasingly complicated as the war progressed. In Le Sueur's opinion, Feraoun "represents the best of two irreconcilable worlds."[83]

Journal 1955-1962: Reflections on the French-Algerian War by Mouloud Feraoun presents the reader with a detailed, personal, and heartfelt chronicle of the French-Algerian War. The entries reveal much about the daily occurrences of the war, Feraoun's struggle with his personal identity, his disdainful opinions of the FLN and the French army, and his cautionary approach to the violence of the war. The brutality on both sides of the conflict and the end of

---

[76] Le Sueur, Introduction. In M. Feraoun, *Journal, 1955-1962*, xxxvii
[77] Ibid.
[78] Ibid. xlvii
[79] Thomas, M. (2001). Mouloud Feraoun, Journal 1955-1962: Reflections on the French-Algerian War. *Journal of Imperial and Commonwealth History*, *29*(2), 191.
[80] Ibid.
[81] Ibid.
[82] Le Sueur, Introduction. In M. Feraoun, *Journal, 1955-1962,* xlvii
[83] Ibid. xlviii

Feraoun's hopes of a fraternal relationship between France and Algeria took a toll on the author that became apparent in *Journal*. The poignancy of the journal was sealed within its abrupt ending, the final entry written the morning of Feraoun's death on March 15th, 1962.

Through his journal entries, Feraoun explored and lamented his identity conundrum. He admired France and felt duped by her demise; in his eyes she no longer embodied a long-standing tradition of the universal values of liberty, equality, and fraternity since she embarked on this violent crusade to hang on to colonial Algeria. Feraoun never denied his allegiance to French culture and the Algerian national movement and he stayed true to his Kabyle heritage. He both criticized and loved the opposing sides of the French-Algerian conflict. Throughout *Journal*, Feraoun exposed the reader to the complexities of his identity as he tried to reconcile his multifaceted nature as the conflict wore on.

Feraoun tried to make sure that the reader would not get the impression that he was passively watching the war unfold as the two dominant sides of his identity crisis destroyed each other. Indeed, Feraoun's *Journal* reads as a warning about the continued use of violence, the dangers of the FLN's blending of patriotism and Islam, and the stubborn desire to decimate all remnants of the colonial period. Feraoun was especially indignant over the destruction of school buildings and the growing power of the national party. Unfortunately, heart-wrenching lamentations like the following remained unanswered as *Journal* suddenly came to an end: "What am I then, dear God? Is it possible that as long as there are labels, there is not one for me? Which one is mine? Can somebody tell me what I am!"[84] At last relieved from the difficulties of establishing his identity and having written his final journal entry, Feraoun died assassinated by French terrorists, neither a traitor nor a hero.

Conclusions

Attentive readings of Mouloud Feraoun's *Le Fils du pauve* and *Journal 1955-1962: Reflections on the French-Algerian War* reveal Feraoun's personal identity struggle as a French-educated Algerian prior to and during the war for independence. Both works shed light on the self-identification difficulties of a man who felt deeply connected to France and to Algeria and found himself by asserting his mixed loyalties. In his first novel, *Le Fils du pauvre*, Feraoun told the story of his growing up in Kabylia, his French educational journey, and the harsh realities of life in Kabylia during and following World War II by effortlessly blending his sense of belonging to both cultures. He accomplished this through the ambiguous nature of this autobiographical novel, his use of the French language to write about life in Kabylia, and his choice to ascribe his life story to a character—Menrad Fouroulou—while still writing a novel—an occidental art form—in addition to his use of European literary references to talk about his upbringing in Kabylia. This *mélange* of French and Algerian elements points to the internal identity struggle Feraoun experienced as he tried to reconcile his ties to both cultures.

Journal allowed Feraoun to meditate on the effects of the war on both sides of the conflict. His identity struggle is apparent in his daily musings because the war affects him and those around him on a personal level while he lived first in Kabylia and later when he moved to

[84] Feraoun, *Journal, 1955-1962,* 65-66.

Algiers. In one entry, Feraoun rhetorically asked what his proper "label" was, and—knowing that he did not actually want one— asked that one be given to him to end his miserable identity anxiety.

A number of entries reveal Feraoun's concern for post-colonial Algeria, especially the effect of violence on Algerian society, the growing power of the nationalist party, the FLN's dangerous intertwining of Islam and patriotism, and the determination to annihilate all remnants of the colonial period—Feraoun was especially intolerant of the destruction of school buildings. Feraoun's *Journal* not only recorded his feelings about his own identity, but also the shift in the way that those around him treated him. Crying out against the lies that his "adoptive French mother" fed him, Feraoun came to terms with the fact that although he felt culturally French, no one else would ever qualify him that way; addressing the lies the colonial system told the Algerians indicated Feraoun's disenchantment with France and her so-called universal values of liberty, equality, and fraternity. Along with his disappointment in his adoptive culture, Feraoun abandoned his hope for a fraternal partnership between France and Algeria as the war droned on.

Mouloud Feraoun, an ambiguous Algerian, amidst his struggle for identity, consistently acted upon his loyalty to his French and Kabyle culture. His admiration for the French manifested itself in his profession as a schoolteacher and his use of devices and concepts he learned through the colonial education system. On the other hand, his apparent allegiance and love for the Algerian people are evident in his honoring of North African traditions, his warnings against future strife in Algeria, as well as his insistence against ever betraying his people. Feraoun's struggle to define himself is evident in *Le Fils du pauvre* and *Journal 1955-1962: Reflections on the French-Algerian War*. Mouloud Feraoun, "Algerian writer of the French language,"[85] did not die "seated between two chairs," but very well seated on his own, saddened by the failure of the French to live up to their proclaimed values, yet enthusiastic for the future of Algeria, a unique voice seeking the truth of the colonial situation to help guide future generations of Algerians.[86]

Mohamed Moulessehoul (Yasmina Khadra)

Mohamed Moulessehoul of the Doui Meniâ tribe was born on January 10th, 1955 in Kénadsa in the Sahara Desert of southwestern Algeria. In September 1964, at the age of nine, Moulessehoul's father dropped him off at *l'École Nationale des Cadets de la Révolution*, a military academy near Tlemcen where he would begin his military career. During his thirty-six year military career, Moulessehoul published twelve books under the pseudonym "Yasmina Khadra"—his wife's first two names—to avoid military censorship of his works. Having left the army in 2000 to devote himself entirely to his literary career, "Yasmina Khadra" revealed *his* true identity in 2001 to the shock of fans and critics of his works. Khadra is married with three children and currently lives in Aix-en-Provence, France; he has been the director of the Algerian Cultural Center in Paris, France since 2007.

[85] Thenault, Mouloud Feraoun, 65. (my translation).
[86] McNair, An Algerian-American Primer, 190.

An interview of Yasmina Khadra conducted by Youcef Merahi was transcribed in a short book, entitled, *Qui êtes-vous, Monsieur Khadra?* (*Who Are You, Mr. Khadra?*). The first question Merahi asked Khadra concerned how the interviewer should address the author; Khadra replied that Merahi can address him "like everyone else does, as Yasmina Khadra." Khadra decided to keep the pseudonym even after having revealed his true male—and former military—identity. When asked why he continued to write behind a woman's penname, he replied that it is a way for him to defend femininity, and show that there is no shame in recognizing the courage and the strength of women: "I am proud to write under a woman's penname. It increases my self-esteem and places me on the same level as all of the women whom I love and admire: my wife, my mother, my daughters, my sisters, Hassiba Boulmerka..." In his view, Algerian women never betray their people or break promises in trying times.[87]

Khadra served in the post-colonial Algerian army for over thirty years as a lieutenant, a captain, and a major; educated in French and Arabic at successive military academies, he chose to write French novels. Khadra stated in his interview with Merahi that he refused to let his military identification number and his military career sum up his entire person. [88] He took a penname to reinvent himself, to distance himself from his military identity and to create a new identity: a French writer.

Yasmina Khadra enjoyed success in France and was quickly "clasped to the Gallic literary bosom as a writer who would, finally, give an insight into what Arab women were really thinking."[89] At the time, the Algerian military faced opprobrium in the French media as a result of the army's violent conflict with armed Islamist radicals. For this reason, in 2001 when Yasmina Khadra revealed his true identity, the French literary community was utterly shocked. To add to the French literary community's distress, this man not only served in the Algerian army, but held positions of high authority. "There were many misunderstandings because people found it hard to understand a writer who was a soldier," Khadra confided in an interview with a British newspaper, "I had to really fight against those who did not appreciate my work because they pigeonholed me as some sort of brute who was responsible for military massacres."[90]

In response to the allegations accusing the Algerian army of massacring civilians during the repression of the Islamist radicals, Khadra countered, "In the eight years I led the fight against terrorism, there were no massacres. Let me tell you, it was a hard battle—there is no honesty or integrity among the pseudo-intellectuals I had to take on. There's much more honesty and integrity among soldiers, trust me."[91] Khadra had to cope with his readers' misunderstanding of his military identity. Somewhat paradoxically, writing under the name Yasmina Khadra may have been a way to simplify his identity: he was an Algerian woman writer. Certainly, readers had preconceptions about what that might mean, but nothing like those he expected "pseudo intellectuals" would have toward an officer or what his military peers might think of a French

---

[87] Khadra, Y., & Merahi, Y. (2007). *Qui êtes-vous, Monsieur Khadra?* (p. 17, 19-20). Algiers, Algeria: Éditions Sedia

[88] Ibid. 20

[89] Jeffries, S. (2005, June 22). G2: Inside Story: Reader, I'm a he: When novels by 'Yasmina Khadra' first appeared, literary France thought it had at last found the authentic voice of the Arab woman. But then she turned out to be a man—and not just a man but a veteran Algerian army officer. Stuart Jeffries meets Mohammed Moulessehoul. *The Guardian (London)*, p. 4.

[90] Ibid.

[91] Ibid.

writer and poet. The adoption of a penname uncomplicated Khadra's life in a number of ways; he was able to write freely and avoid military censorship, and maybe writing as a woman was the best disguise.

Yasmina Khadra exhibited a "Westernized" consciousness of women that one would not typically expect from a man of his background. When asked why he chose to write under his wife's name in particular, he responded, "You don't understand, it was my wife who suggested that I use her name." Khadra affectionately referred to his mother as the reason that he remained in the army even though he itched to become a writer, "For my mother it was her greatest hope that I was a soldier and continued the work my father had done. I [stayed in the army] to console my mother. I willingly sacrificed 36 years of my life for her."[92] In these references to the women in his life Khadra comes off as a true romantic; his wife "insisted" that he use her name and he selflessly remained in the army for the sake of his mother's dreams. I think he behaves like a stereotypical Frenchman—charming, and a true gentleman with regard for women and their opinions.

Khadra cited his elder Algerian writers—including Mouloud Feraoun—as inspiration to tackle writing himself. Khadra admitted that the first time he read the work of Algerian poet Malak Haddad he was awestruck, and decided that he too would create irresistible literature.[93] Khadra also cited Albert Camus and John Steinbeck as inspirations for his writing. Khadra presented himself as versatile because of his immersion in two literary traditions: "I have written a western tragedy, but also a book that is filled with eastern storytelling. When there are two perspectives there's a better chance of understanding."[94]

Khadra's identity is full of contradictions. He was an army officer and a novelist; he is a man with a woman's name. He was educated in French and Arabic, born in the Sahara desert, but currently lives in France, and inspired by Algerian and Western authors. Mohammed Moulessehoul seems to have embraced his multi-faceted identity and denies its contradictory nature. He rejected the categories of "soldier" or "Arab woman writer" as definitive, responding in his own way to expectations about the "native intellectual" even if his public might see him as a man with a mask or a (woman) writer who turned out to be a fraud.

L'Écrivain (The Writer)

L'Écrivain, published in 2001, played an integral role in the "unveiling" of Yasmina Khadra. This first-person autobiography told the story of Moulessehoul's growing up in the military academies of Tlemcen and Koléa. Divulged in the title, this autobiography focused on Khadra's maturation into a young man who came to excel in and appreciate reading and writing first in Arabic and then increasingly in French; Khadra believed that he was destined to become a writer: "I feel deeply that I was brought into this world to write."[95] The title speaks to the type of writer that Yasmina Khadra became— a French writer:

---

[92] Jefferies, G2: Inside story, 4
[93] Khadra & Merahi,. *Qui êtes-vous,* 22
[94]Jeffries, G2: Inside Story, 4
[95] Khadra & Merahi, *Qui êtes-vous,* 20

> It was while reading *Le Petit Poucet* that the light came on and I received a revelation. The verb was a gift from above. I was born to write! In reading this beautiful book, thumbing the splendidly illustrated pages, dazzled with profound affection, I was incurably fixated: I had to write books… I was *fascinated* by words… this assembly of dead characters who, arranged between a capital letter and a period, suddenly came back to life, became sentences… and demonstrated strength and spirit.[96]

In 1966, Khadra wrote his first text, a readaptation of the *Le Petit Poucet* in Arabic; he submitted his story to his teacher who relayed it to the one of the lieutenants at the academy. Khadra's inaugural attempt at literature earned him a spot on the list "des récompensés" ("rewarded") or the students who performed well enough during the week who received the privilege of attending a soccer game at the local stadium on Saturday afternoon.[97]

Despite this instance of success, Khadra revealed that during his first few years as a cadet that he performed best in his Arabic classes and did very poorly in his French classes until he entered middle and high school at Koléa. There, no matter how well he did in his Arabic classes, his Arabic teachers took offense to the fact that a young boy attempted to produce traditional Arabic poetry. Khadra informed his readers that, in fact, he was a descendant of revered Algerian poets of old such as Sidi Abderrahmane Moulessehoul and Sidi Ahmed Moulessehoul.[98] In contrast, even though Khadra did not excel in his French classes, he received more encouragement from his French teachers. Khadra credited his eighth grade French teacher, M. Kouadri for solidifying French as Khadra's "writer's language."[99]

Even though he chose French as his language of composition, Khadra still felt a deep connection to the land of his ancestors, Algeria, and her people. In a particular passage, he romanticized the *souk* market he encountered while living with his mother in Petit Lac, a slum of Oran:

> Since I was a little boy, I have always been drawn to markets. Their fairground atmosphere takes me back to my long-lost tribe, replenishes me in my authenticity. This is also another way for me to escape the blues. Every time I feel down, I head to a market—any market—and I experience lasting relief. In addition to its therapeutic virtues, the *souk* represents Algeria: profound, hardy and rough, bustling and stubborn, conscious of going adrift but not caring enough to prevent it.[100]

Khadra consistently confessed his admiration for the mystery and hidden beauty embedded in his ancestors and in his vast country. His country's cultural traditions—like the *souk*—soothed him and, in a way, helped to remind him of who he was and where he was from as he fought to find his place in the world.

Khadra continued to develop his Francophone literary talents, and even started a drama club at the academy—under the guidance of Algerian author and playwright Slimane Benaïssa—and he wrote and produced plays in both languages. Khadra regularly produced short stories and

---

[96] Khadra, Y. (2001). *L'Écrivain* (p. 88-89). Paris, France: Julliard. (my translation)
[97] Ibid. 89
[98] Khadra & Merahi, *Qui êtes-vous*, 20
[99] Khadra, *L'Écrivain*, 151
[100] Ibid. 74-75 (my translation).

essays which one of his friends faithfully critiqued for him; another one of the cadets acted as Khadra's literary agent and sold his works to the benefit of both of them. Khadra earned the respect of his peers through his genius as a playwright, an actor, and as a storyteller. While at Koléa, Khadra's classmates highly anticipated his return from a visit home because he would satisfy their craving for excitement with funny and emotional stories. As soon as Khadra's silhouette became visible on as he approached the academy, someone would alert the others, "'Hey, guys! Moulessehoul is coming'" and the cadets would fill the dormitory as Khadra got closer, "the cadets would greet me, loudly and full of joy." Khadra did not bother to unpack before launching into his whimsical narratives.[101]

Khadra did not, in the end, resist the tough discipline of the military, and instead of losing himself, he suggested he found himself in this strict environment in his account of the painful separation from the father he loved. After his father left his mother and her seven children to be with another woman, Khadra lost respect for him and recognized that the academy was his true home. While the cadets spent their summer break at Port-aux-Poules, a summer camp fifty kilometers west of Oran, Khadra's father paid his son an impromptu visit:

> His visit shook me, as though lightening zapped through me. But I stood my ground. Somewhere, I believe that he [Khadra's father] will always be the man I used to think could be God, I just lost faith in him. He was not alone… A little ways away, a pregnant woman was watching me… My attitude threw him off a bit. He was not sure how to interpret my behavior: I had saluted him militarily and stayed "at attention" … For a long time we stared at each other in silence… a confused and crippling silence… I was not upset with him, no, I just felt like we did not have anything more to say to each other. This saddened me; I was much sadder than him, sadder than the entire world… For me, a universe had crumbled and an age had come to an end. Without giving him the chance to hold me back, I took a step back, brought my hand to my temple in an impeccable salute, turned around and returned to my instructors, to my *real* family… My heart had officially switched sides.[102]

At this point, Khadra accepted this military family as his "*real*" family. The challenge was to define himself as a French writer and as Cadet Matricule 129.

Khadra quickly learned that in the army, no one was supposed to stand out or be special; everyone must be on an equal plane so as not to jeopardize the established hierarchy of power. He uses the following story to convey the situation. At the academy, during Ramadan, some boys were late to the mess hall to eat the morning meal before the observation of the fast. When the supervisors did not let the tardy boys in, they began to kick at the doors and bang on the windows of the mess hall and their comrades eating inside the hall demanded that their peers be let in to eat. Chaos ensued, including a fight involving officials of the academy and students who demanded to speak to the commander in chief of the academy. Since such mutiny had no precedent, the administration was unsure of how to handle such behavior. During these events, Khadra had been sitting in a classroom working on a collection of short stories; he heard the commotion, but did not participate in the protests. Yet, he received the blame for the cadets' behavior because all of the cadets talk about him; he was too popular and the military will not

[101] Khadra, *L'écrivain*, 187 (my translation)
[102] Ibid. 92-93 (my translation).

tolerate "celebrities" or "superstars." This marked his first encounter with military censorship and the reality that he cannot be who he truly is—or aspires to be—as long as the depersonalizing military confiscates his personal sense of self.

Unable to write freely as a soldier and wary of ostracism by the literary community because of his military past, Khadra sees himself as an outsider: "If I had to sum up my life in one word, I would choose the word 'exclusion,' I feel like that word was created for me." Khadra himself rejects all labels but the one he ascribes to himself: *l'écrivain*, "to write is to be free."[103]

Ce que le jour doit à la nuit (What the Day Owes the Night)

One of Khadra's best-selling novels, *Ce que le jour doit à la nuit*, published in 2008, is significant to this study because it tells the story of Younes, who transformed from a poor, illiterate Arab boy from the countryside into "Jonas"—an assimilated, French-educated, young man from a well-to-do family living in a European-Algerian coastal town. [104] Younes—who is the protagonist and the narrator of the novel—embodied the idea of the divided self as he struggled with his identity as an Arab or as a "European through education and assimilation."

Khadra decided to situate this novel in the years of the generation before him. This novel begins in the 1930s and chronicles the American forces' entry into Algeria in the 1940s during World War II. The novel covers the 1950s and 1960s leading up to and during the Algerian War for Independence, stops in 1964, and resumes in 2008 in the final chapter. Khadra's novel creates a character who is pressured to pick "sides"—the French or the Algerian side—but Younes chooses not to rebel with the Algerians. This is contrary to Fanon and Memmi's view that rebellion is the only way for the colonized to satisfy his sense of justice and realize himself. In his sympathetic portrayal of Younes, Khadra demonstrates the difficulty of the choice between the two cultures and suggests that choosing not to fight can be an act of defining oneself just as meaningful as choosing to fight.

The first instances of Younes' double nature can be found in the mixed marriage of his adoptive parents and his acquisition of a new name. Younes and his biological family relocated from the Algerian countryside to the slums of Oran when his father's fields were destroyed in a fire; in the slums, his father was robbed by a notorious mugger and lost all of his savings. As a result of these misfortunes, Younes' father entrusted the well-being of his only son to his brother, Mahi—an Arab—and his wife Germaine—a European. This mixed couple had no children of their own and ran a pharmacy together in the European part of Oran; their marriage represents the possible harmony between the Europeans and the Algerians. They treated Younes as their son and renamed him "Jonas;" initially confused, Younes came to accept this new name, which marked the beginning of his metamorphosis into an assimilated European man.

Younes' struggle with identity formation also manifests itself during his education in Oran and in Río Salado. One day in elementary school, Younes witnessed the humiliation of one of his Arab classmates who, having forgotten his homework, was forced to stand in front of the class and attribute his absentmindedness to the supposed faineance of his race. Appalled and

[103] Khadra & Merahi, *Qui êtes-vous*, 25, 27 (my translation).
[104] I will refer to the protagonist of the novel by his Arabic name, "Younes."

embarrassed for his classmate, Younes came home angry from school and asked his uncle if Arabs are lazy. Mahi replied, "We are not lazy. We just take the time to live… for [the Europeans], time is money. For us, time has no price attached to it. A cup of tea is sufficient for our happiness, but for them, no happiness is enough."[105] This embarrassment from elementary school contrasted with Younes' later easier integration into a group of European boys in Río who treated him as an equal.

Even though Río Salado was a primarily a European town, Younes connected with its agrarian character because it reminded him of his own rural roots, or his identity before his assimilation to European culture. Mesmerized by his radiant, sun-bathed, coastal surroundings, Younes felt right at home:

> Born and raised in the fields, I recovered my old points of reference, the smell of agriculture and the silence of the earth. I was reborn as a farmer, happy to discover that my city clothes had not corrupted my soul. If the city was an illusion, the countryside will be an ever-deepening emotion.[106]

The idyll of Río, however, proved to be superficial. Khadra illustrates Younes' uncomfortable encounters with racism among his European friends in one scene at the beach, where Younes and his friends watched with mounting horror as André continued to send Jelloul—his Arab valet—on foot back and forth from the beach to the inland town on petty errands during a serious heat wave. The fourth time André sent Jelloul back to the village, Fabrice and José protested while Younes remained silent:

> -It's the only way to keep him awake, André said, putting his arms behind his head. If you let him alone one second, you'll hear him snoring.
>
> -It's at least 37 degrees, Fabrice pleaded. The poor devil is skin and bones like you and me. He's going to get sunstroke….
>
> -This is none of your business José, you don't have any valets… the Arabs are like octopi; you have to beat them into submission.
>
> Realizing that I [Younes] was one of them, he rectified:
>
> -Well… some Arabs.[107]

Once André moved out of earshot, Fabrice confronted Younes about his silence:

> -You should have shut him up, Jonas.
>
> -On what subject, I said, disgusted.
>
> -The Arabs. What he said was unacceptable and I was waiting for you to put him in his place.
>
> -He already is in his place, Fabrice. I don't know mine.[108]

---

[105] Khadra, Y. (2008). *Ce que le jour doit à la nuit*. (p.94) Paris, France: Julliard. (my translation).
[106] Ibid. 123 (my translation).
[107] Ibid. 145-146 (my translation).

Younes' last reply demonstrated the young man's uncertainty about his place in the colonial dynamic of dominance and his ambiguous place among his friends—should he have said something to André to defend his people? What kept him silent? This is evidence of Younes' internal division between "Jonas"—his assimilated European self—and "Younes," his Arab self.

André's continued mistreatment of Jelloul became particularly painful for Younes because it forced him to confront his anomalous situation as an Arab among Europeans. Jelloul's character forced Younes to see himself as Arab and ultimately compels him to choose a "side" in the war for Independence. Younes and Jelloul had a number of different encounters and conversations. During the first of these, Younes got a glimpse of the circumstances of Jelloul's life. One evening, Jelloul came to Younes in need of money to feed his family for a few days because André had beat him up and sent him away without paying him. Jelloul conveyed his confidence to Younes that André would call him back to work for him sooner than later: "André can't do without me. He'll come get me before the end of the week. He won't find a better dog on the market."[109]

When Younes asked Jelloul why he characterized himself in such a harsh manner, Jelloul offered this reply:

> You, you can't understand. You are one of *us*, but you live *their* lifestyle…When you are the only breadwinner of a family composed of a half-crazy mother, a double-amputee father, six brothers and sisters, a grandmother, two disgraced aunts and their offspring, and an uncle who is sick year-round you stop being human… Between the dog and the jackal, the docile beast chooses to have a master.[110]

Younes, astounded by the violence in Jelloul's words, saw an impressive maturity in his peer.

After giving him more than enough money, Younes offered to take Jelloul back to his *douar* on the back of his bike, and there he saw the economic division between the two communities and his eyes were opened to the exploitation and misery of his people. Upon their arrival at the edge of the Arab village, Younes, repulsed by the overwhelming filth and stench emanating from the hamlet, watched in alarm as little boys played naked in the dust as flies buzzed noisily around the whole establishment. Sensing his companion's uneasiness, Jelloul smiled and said to Younes:

> This is how our people live, Jonas. Our people who are also your people. Except that they remain stagnant while you're taking it easy…What's wrong? Why aren't you saying anything? You can't believe it, right? ... Now I hope you understand why I was talking to you about being a dog. Even animals would not accept to fall so low.[111]

Sick to his stomach with the misery and the foul odors before him, Younes tried not to vomit as Jelloul continued, "Take a good look at this hellhole. This is our place in this country, the country of our ancestors. Take a good look, Jonas. God has never passed through here." Horrified, Younes mounted his bike and turned around to leave as Jelloul shouted after him,

---

[108] Khadra, *Ce que le jour*, 146 (my translation)
[109] Ibid.186 (my translation).
[110] Ibid. (my translation).
[111] Ibid. 188-189 (my translation).

"that's right *Younes*. Turn your back on the truth about your people and run back to your friends… *Younes*… I hope that you still remember your name... Hey! *Younes*… The world is changing, haven't you noticed?"[112]

Following his encounter with Jelloul's village, Younes felt torn between loyalty to his European friends and solidarity with his people.[113] In his mid-twenties, with war on the horizon, Younes often returned to Oran by himself to get away from the drama of Río Salado. While alone, he questioned himself:

> Who was I, in Río? Jonas or Younes? Why, when my friends laughed heartily, my laugh lagged behind theirs? Why did I always feel like I had to carve out a space for myself among my friends, and feel like I was guilty of something whenever Jelloul's eyes met mine? Was I tolerated, integrated, subdued? What was stopping me from fully being *me*, to personify the world in which I evolved, to identify myself with that world while I turned my back on *my people*? A shadow. I was a shadow, indecisive and sensitive.[114]

Jelloul continued to challenge Younes' ambivalence until the end of the novel; Khadra juxtaposed the two characters to show the extreme course of action Younes could have taken to fight for his country's independence. Before the outbreak of the war in 1954, Jelloul, falsely accused of murdering Younes' friend, José—André's brother—was hauled off by the police to be executed. Unable to save her son, Jelloul's mother came to Younes to beg him to convince José's father to stop her son's execution. An embarrassed Younes attempted to reason with the wealthy vineyard owner to no avail:

> -Jelloul could be innocent.
>
> -Are you kidding? I have employed Arabs for generations, and I know what they are. They are all snakes… That viper confessed. He was condemned. I will personally make sure that his head falls into the basket… This is very serious Jonas. This is not a punch to the face, but a real war. This country is shaking, this is no time to play both sides of fence. We have to come down just and hard. No leniency will be tolerated. These crazed murderers need to understand that we won't back down. Every bastard we catch must pay for the rest of them…
>
> -His [Jelloul's] family came to see me…
>
> -Jonas, my poor Jonas, he interrupted me, you have no idea what you're talking about. Young man, you were well-brought up, you are integrated, and intelligent. Stay out of this hooligan business. You won't be as confused.[115]

Even though Younes' talk with José's father led nowhere, Jelloul escaped en route to prison when one of the transport vehicle's tires exploded and the vehicle plunged head first into a pit.

Jelloul joined the resistance movement and sought out Younes when one of his leaders was injured and a group of resistance fighters occupied Younes' home. This is the occasion of

---

[112] Khadra, *Ce que le jour*, 189 (my translations).
[113] Ibid.
[114] Ibid. 284 (my translation).
[115] Ibid. 302 (my translation).

two significant exchanges between Younes and Jelloul. On the first night of his stay, Jelloul pushed Younes to join the fight on the resistance side:

> -Everything is fine and dandy for you, huh? ...The war doesn't concern you. You're still taking it easy while we're hitting a brick wall in the *maquis* [resistance]… When will you pick a side? You'll have to decide eventually…
>
> -I don't like war.
>
> -It's not about liking or disliking war. Our people are rising up. We are tired of suffering in silence. Of course, you with your butt between two chairs, you can maneuver at will. You can pick the side that benefits you.[116]

Jelloul mocked his noncombatant peer's concern only with saving his own skin, "the war claims hundreds of lives every day and doesn't affect you. I would shoot you like a dog if I wasn't indebted to you… Actually, can you explain why I have a hard time calling you Younes?"[117] With that last contemptuous question, Jelloul associated Younes' Arab name with his Arab identity and with the war effort. Because Younes refused to partake in the war at all—not even on his people's side—Jelloul had a hard time respecting Younes' "Arabness."

For Jelloul, to be a man is to hold a gun, and he demonstrated this belief when he put a fully-loaded revolver in Younes' hands—"the coolness of the metal sent chills down my spine." When Younes did not accept it, Jelloul disparaged him: "Frankly Younes, my heart bleeds for you. Only the lowest of the low would pass over a grand destiny," before taking the revolver back.[118]

Finally, Younes fought back—challenging Jelloul's association of the gun with manly character. At this moment, Younes took a stand and asserted his right to be independent:

> -You're nothing but a coward. What's happening in the villages bombarded with napalm, in the prisons where our heroes are guillotined, in the *maquis* where we scrape up our dead, in the camps where our militants are languishing, you don't see it. What kind of maniac are you, Jonas? Don't you understand that a whole population is fighting for your own redemption? … You're nothing but a coward, nothing but a coward. Whether you frown or gird your loins nothing changes. I wonder what's stopping me from slitting your throat…
>
> -What do you know about cowardice, Jelloul? Who do you think embodies that characteristic? The unarmed man who has a gun to head or the one who threatens to blow out his brains?
>
> He glared at me with disgust.
>
> -I am not a coward, Jelloul. I am not deaf or blind, and I'm not made of concrete. If you must know, nothing on this earth matters to me. Not even the gun that allows you to treat

[116] Khadra, *Ce que le jour*, 337 (my translation).
[117] Ibid. 339 (my translation).
[118] Ibid. 341 (my translation).

> others with contempt. Was it not humiliation that compelled you to carry a weapon? Why are you exercising this yourself today?[119]

Jelloul stopped confronting Younes after that day.

Younes chose not to take up arms, but helped the resistance by providing the medical supplies from his pharmacy needed to help the resistance's infirmary who sent him a list of what was needed in advance. When arrested for collaboration and tortured for the purpose of obtaining information about the resistance, Younes did not betray his people and reveal anyone's names. He was rescued from torture and further questioning by a notable European from Río Salado—Pépé Rucillio—who advocated for his release.

Younes' experience in the Algerian resistance terminated his ability to relate to Germaine. In helping the resistance, Younes became "an Algerian man" as per Jelloul's way of thinking and this estranged him from his European adoptive mother. Germaine's initial happiness to recover her son alive evaporated at the coldness of Younes' tone as he questioned her about how Pépé Rucillio was able to save him; hurt, Germaine became angry and resentful of her adopted son. Younes described their falling-out: "I understood that the rope that kept me attached to her had just been unraveled, that the woman who had been everything to me—my mother, my good fairy, my sister, my accomplice, my confident and my friend—now only saw a stranger in me."[120]

Jelloul and Younes had one final encounter when the war ended in the spring of 1962 in which Jelloul repaid Younes for lending him money and taking him home years ago. Jelloul had moved up to the rank of lieutenant in the Algerian army and sent a car to Río to bring Younes to Oran to finally repay his debt. One of Younes' European friends—Jean-Christophe— was a militant in the *Organization de l'armée secrete*, a pro-colonialism French terrorist organization. Jelloul made sure that Younes' friend stayed alive so that Younes could be the one to set him free; Jelloul told Younes:

> I have not forgotten the day when you gave me money and took me back to my village on your bike. For you, it was nothing. For me, it was a revelation: I had just discovered that the Arab, the fine Arab, the Arab dignified and generous was not an old myth, nor what the *colon* made of him… I am not learned enough to explain exactly what happened in my head that day, but it changed my life.[121]

The day that Younes took Jelloul home was significant for both individuals. Younes's eyes were opened to the misery of most Algerians and the divide between the colonizer and the colonized and Jelloul saw that Younes was not one of "them"—the Europeans—but an Arab. After freeing his old friend, Younes stayed in Río Salado—El Malah after independence—and continued to live there in the present day when the novel ends.

At the end of the novel, Younes appeared to be comfortable in his own skin. He chose to remain in Algeria and still maintained close ties with his European friends. They still accepted Younes for who he is, which points to the possible fraternity between the Algerian and the

---

[119] Khadra, *Ce que le* jour, 343 (my translation).
[120] Ibid. 352 (my translation).
[121] Ibid. 368 (my translation).

Europeans. The novel concludes with Younes and his European friends gathered in Aix-en-Provence to pay their respects to Émilie—one of their deceased friend's wife— who recently passed away. Younes and his friends talked about the Algeria that they knew, before independence and Younes updated everyone on the current state of affairs in Río/El Malah and in Algeria. Called over the intercom in the airport to report to his gate to catch his plane back to Oran as "Monsieur Mahieddine Younes," the protagonist was at peace with his Algerian-ess as well as his ties to the European community.

In conclusion, in his masterpiece of French romance literature, *Ce que le jour doit à la nuit*, Khadra commented on the divided self through the main character of the novel, Younes. Jelloul's character was particularly significant because through this character, Khadra brought attention to Younes' growing awareness of what it meant to be Arab or European in Algeria and his struggle to define himself. A series of oppositions—Arab father figure and European adoptive mother, "Younes" and "Jonas," resistance fighter Jelloul and his European friends, the European town of Río Salado and the Arab countryside, noninvolvement and supporting the uprising of his people—deeply affected Younes as he tried to reconcile all of the components of his identity. These contradictions first served to point out Younes' dividedness, but Younes' character also showed that these opposing factors could exist in harmony with one another. Through Younes, Khadra demonstrated that one can be at peace with oneself through the nonpartisan emotion of love—love of family, love of country, love of friends.

Conclusion

Two of Yasmina Khadra's works analyzed in this paper—*L'Écrivain* and *Ce que le jour doit à la nuit*—deal with the concept of the divided self; Khadra is personally familiar with the difficulty of identity conflicts, having experienced exclusion from the military milieu because of his vocation to be a writer and rejection from the literary community as a result of this military past. *L'Écrivain*, Khadra's autobiography, discussed the impossibility of combining his compelling vocation to be a writer in the environment of the tough military academies. *Ce que le jour doit à la nuit* is a romance novel whose protagonist, Younes/Jonas, was unsure of his feelings about his place among his friends, among his own people, and in the war for Algerian independence. Through the character Jelloul, Khadra emphasized the evolution of Younes' understanding of what it meant to be European or Arab in Algeria. Younes experienced this internal conflict in terms of various oppositions.

Khadra's own struggles with identity as a writer and as a military officer contributed to the realism and the honesty of his autobiography and transpire in the character of Younes/Jonas. Khadra's writings contain an overarching humanist message that cooperation between differing cultures—military and literary, and French and Arab—was and is possible through the universal emotion of love. Love for family—military for Khadra a mix of Arab and European parents for Younes; love for country—Algeria, and love of friends—European for Younes and fellow cadets for Khadra, provided relief for the discomfort of the divided self in Khadra's view.

Discussion and Conclusions

Mouloud Feraoun and Yasmina Khadra each expressed their struggles with their identity in their novels and autobiographies and they rejected the notion put forth by Fanon and Memmi that one cannot be both culturally French and Algerian. The autobiographies of the authors explained their experience with their identity struggle, and in their novels, the authors ascribed their internal conflicts to a protagonist to illustrate the effects of and coping strategies for this identity conflict.

Living during colonization and dying days before its end, Feraoun wanted freedom for Algeria, but did not hide his disappointment in France for failing to uphold the admirable values he learned in school; Feraoun desired to see Algeria as an independent state, but he also desired fraternity between France and her former colony. He expressed these feelings toward France and Algeria in *Le Fils du pauvre* through the character of Fouroulou and his fellow Kabyles, and in *Journal 1955-1962: Reflections on the French-Algerian War* where his introspective soliloquies revealed the extent to which Feraoun refused "to pick sides" and simply wished to remain seated in his own "chair."

A member of the following generation of Algerians, Khadra lived in post-colonial Algeria. He desired acceptance from his new Algerian military "family," but this clashed with his self-proclaimed destiny to become a French writer; now that his military career is over, instead of allowing people to pigeonhole him as one thing—a violent military officer—or another—an imposter—Khadra seeks to prove that two seemingly irreconcilable identities can exist in harmony. Khadra demonstrated this coming to terms with one's differing identities through his own story about discovering his love for writing in French in *L'Écrivain*. Khadra's novel, *Ce que le jour doit à la nuit*, takes place prior to and during the Algerian war, and through the character of Younes—who goes through the identity conflict of feeling pressured but unable to choose sides—Khadra shows that just as it is possible for Younes to make peace with the different facets of his identity, so Khadra also can be at peace with his identity.

Though each generation had different problems complicating the authors' identity struggles, they both reject the impossibility of being both French and Algerian and envelope their opposition in an overarching positive message of intercultural fraternity and cooperation. In Feraoun's generation, the primary concern was whether to support the French—who educated him—or to support the Algerian resistance and his people; this generation of Algerians also feared that their non-involvement in the war meant betrayal to their people, but involvement in the war meant betrayal to the French who had saved them from a life of poverty by educating them. Feraoun reconciled his internal conflict by asserting his comfort "sitting on his own" instead of being divided between two opposing sides. Khadra's generation sought a firm declaration of Algerian-ness in the first few years following independence. Khadra experienced rejection from the military during his career and from the literary community following the end of his military career. Khadra, however, refused to be limited to one identity or the other. He finds peace in defining himself.

This research shows how despite Fanon and Memmi's claims that the "native intellectual" cannot be French and Algerian, Feraoun and Khadra reject this notion. They defined themselves first and foremost as writers. Their autobiographies and novels are a testament to this justification for self-definition in the compartmentalized environment of colonial and post-

colonial Algeria. Their work argues for and is evidence of a more nuanced view of the cultural products of colonialism. They rejected simple dichotomies in defining individuals and culture and showed how francophone literature can be distinctively hybrid. Each man, writing in French, was informed by French (and even American) literary culture and models in addition to Arabic literary culture and models. They both wrote about subjects that are meaningful to them and that make sense of their experiences as men of more than one name and multiple identity facets.

Bibliography

Adam, J. (1981, November). Les débuts littéraires de Mouloud Feraoun: de "Menrad Fouroulou" au "Fils du pauvre". *Revue d'Histoire littéraire de la France, 6*.

Belkacem, D. (2005). Du texte autobiographique au texte romanesque dans "Le Fils du pauvre" de Mouloud Feraoun. *Insaniyat,29-3*, 159-173

Colonna, F. (2008). Training the National Elites in Colonial Algeria 1920-1954. *Historical Social Research, 33*(2),

Fanon, F. (1968). *The Wretched of the Earth*. New York, NY: Grove Press Inc.

M. Feraoun, *Journal, 1955-1962: Reflections on the French-Algerian War*. Lincoln, NE: University of Nebraska Press.

Feraoun, M. (2005). *The Poor Man's Son: Menrad, Kabyle Schoolteacher*. Charlottesville, VA: University of Virginia Press.

Gadant-Benzine, M. (1978, July). Mouloud Feraoun, un Algérien ambigu.? *Peuples Mediterranéens, 4*.

Groden, M., Kreiswirth, M., & Sze man, I. (Eds.). (2005). Postcolonial Cultural Studies: 1. Origins to the 1980s. In *The Johns Hopkins Guide to Literary Theory and Criticism* (2nd ed.). Baltimore, MD: Johns Hopkins University Press. Retrieved July 9, 2013, from Johns Hopkins Guide to Literary Theory and Criticism.

Harik, E., & Marston, D. (1984). *The Politics of Education in Colonial Algeria*. Athens, OH: Ohio University, Center for International Studies.

Heggoy, A.A. (1973a). Education in French Algeria: An Essay on Cultural Conflict. *Comparative Education Review, 17*(2).

Heggoy, A. A. (1973b, December). Kepi and Chalkboards: French Soldiers and Education in Revolutionary Algeria. *Military Affairs, 37*(4).

Heggoy, A. A. (1975). Arab Education in Colonial Algeria. *Journal of African Studies, 2*(2).

Jeffries, S. (2005, June 22). G2: Inside Story: Reader, I'm a he: When novels by 'Yasmina Khadra' first appeared, literary France thought it had at last found the authentic voice of the Arab woman. But then she turned out to be a man—and not just a man but a veteran

Algerian army officer. Stuart Jeffries meets Mohammed Moulessehoul. *The Guardian (London)*.

Khadra, Y. (2001). *L'Écrivain*. Paris, France: Julliard.

Khadra, Y. (2008). *Ce que le jour doit à la nuit*. Paris, France: Julliard.

Khadra, Y., & Merahi, Y. (2007). *Qui êtes-vous, Monsieur Khadra?* Algiers, Algeria: Éditions Sedia

Le Sueur, J.D. (2000). Introduction. In M. Feraoun, *Journal, 1955-1962: Reflections on the French-Algerian War*. Lincoln, NE: University of Nebraska Press.

McNair, L.R. (2005). Introduction. In M. Feraoun, *The Poor Man's Son* (pp. 2). Charlottesville, VA: University of Virginia Press.

McNair, L. R. (2006, August). An Algerian-American Primer: Reading Mouloud Feraoun's The Poor Man's Son. Menrad, Kabyle Schoolteacher. *Contemporary French and Francophone Studies*, *10*(2)

Memmi, A. (1965). *The Colonizer and the Colonizer*. Boston, MA: Beacon Press.

Tcheho, I. C. (1982). European Literary References in Mouloud Feraoun's Le Fils du pauvre. *Revue CEFLAN*, *1*(2)

Thenault, S. (1999, July). Mouloud Feraoun. Un écrivain dans la guerre d'Algérie. *Vingtième Siècle. Revue d'histoire*, *63*

Thomas, M. (2001). Mouloud Feraoun, Journal 1955-1962: Reflections on the French-Algerian War. *Journal of Imperial and Commonwealth History*, *29*(2), 191

Wainwright, J. (2005). Book Review: The Colonizer and the Colonized. *Progress in Human Geography*, *29*

Fusobacterium varium Infection in Mice as a Model for the Study of Vaccine Efficacy and Immunogenicity

Catherine M. Guerra, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Dr. Jason W. Brooks VMD, PhD, Diplomate ACVP
Department of Veterinary and Biomedical Sciences
College of Agricultural Sciences
The Pennsylvania State University

Abstract

Fusobacterium varium, a gram-negative, obligate anaerobe, has potentially both beneficial and pathological functions in humans and animals. Recently, *F. varium* has become known as the most common pathogen to cause necrobacillosis in some white-tailed deer (*Odocoileus viginianus*) populations. Many deer farmers vaccinate their herds with the commercially available *Fusobacterium necrophorum* vaccine due to a lack of an acceptable alternative; however, many of these farms suffer from rampant cases of necrobacillosis. This study investigates the effectiveness of four different vaccine preparations in preventing *F. varium* infection in mice. Additionally, the study explores the degree of cross-protection afforded by the vaccines prepared with *F. necrophorum*.

1. Introduction

A gram-negative, obligate anaerobe, *Fusobacterium varium* plays a beneficial role as an integral constituent of the gut microflora (Potrykus et al., 2008). Some recent studies, however, recovered *F. varium* from multiple tissues of farm-raised white-tailed deer with necrobacillosis (Brooks et. al., 2013). This severe septicemic infection results in purulent necrotic lesions that often spread to multiple organs of the body, ultimately causing death (Adler et al., 1990). Recently, *F. varium* was found to comprise a larger proportion of the clinical isolates recovered from gross pulmonary lesions in cases of respiratory tract infections in deer relative to any other *Fusobacterium* species (Brooks et al., 2010). With the exception of decubitus ulcers, *F. varium* isolates from human clinical specimens are somewhat rare, although it has been associated with ulcerative colitis as well (Legaria et al., 2005).

Necrobacillosis is of significant economic importance in the white-tailed deer-farming industry because of costs associated with decreases in total inventory. Individual white-tailed deer have been known to be valued at thousand to tens of thousands of dollars. Traditionally, these deer have been prized by a variety of groups such as hunters, outdoorsmen, and conservationists. As a result, the farming of white-tailed deer has become a growing industry in the United States (Hattel et al., 2004). Recently, the state of Pennsylvania ranked 2nd and 3rd in the United States in numbers of commercial deer and elk farms and number of deer and elk sold,

respectively (PDFA, 2006). Moreover, according to the United States Department of Agriculture, Pennsylvania displayed a 54% increase in farm numbers and a 33% increase in deer numbers between the years 2002 and 2007 (USDA, 2009). Therefore, it is essential to the cervid industry to determine the etiology, pathogenesis, and prevention of necrobacillosis, and subsequent disease conditions, on these farms.

As a result, due to a lack of an acceptable alternative, many deer farmers have responded by vaccinating their herds with the only commercially available *Fusobacterium* vaccine; specifically, a *Fusobacterium necrophorum* bacterin vaccine. This opportunistic pathogen is a gram-negative rod requiring anaerobic environmental conditions (Narayanan et al., 2003). *F. necrophorum* has long been known as a causative agent of necrotic laryngitis, foot rot, and rumentitis-liver abscess complex in cattle (Tan et al., 1996). Numerous studies have previously demonstrated the pathogenic effects of *F. necrophorum* in cattle and mice, while very few have been conducted on *F. varium*, as the organism has long been considered nonpathogenic (Mass, 1986).

As a consequence of this discrepancy, the efficacy of this commercial *F. necrophorum* bacterin vaccine for use in deer remains unclear and could potentially lead to severe economic turmoil for these farms. In order to investigate this problem, three initial pilot studies were conducted to refine key variables such as mouse strain, inoculation dose, and type of adjuvant. Additionally, the first pilot study revealed that *F. varium* alone could not establish infection in mice. Consequently, a second study determined that co-infection with *Arcanobacterium pyogenes* was necessary in order to establish infection. *A. pyogenes* is a facultative anaerobe that has been suggested to utilize oxygen and lower the redox potential to create an anaerobic environment (Tan et. al., 1996). Therefore, the consumption of excess oxygen by a facultative bacterium, such as *A. pyogenes,* seems to be a crucial synergistic property for the establishment of *F. varium*. Ultimately, this study aims to measure the effectiveness of four different vaccine preparations in the prevention of *F. varium* infection in mice. Additionally, the study explores the degree of cross-protection afforded by the vaccines prepared with *F. necrophorum.*

2. Materials and Methods

2.1. Culture

The *F. varium* isolate P11V used in this study was initially recovered from the respiratory tract of a white-tailed deer at the Animal Diagnostic Laboratory at The Pennsylvania State University. Identification was based upon the RapID ANA II system (Remel, Lenexa, KS, USA), 16S rDNA sequencing, and biochemical characteristics. The RapID ANA II panel is based on the detection of secreted bacterial enzymes and thus does not require live organisms (Burlage, 1985). It has been found to be an acceptable rapid test system for identifying many of the clinically significant anaerobic bacteria, such as *Fusobacterium* species (Celig, 1991). Cultures were maintained on sheep blood agar plates at 37°C in an anaerobic chamber containing 5% carbon dioxide, 5% hydrogen, and 90% nitrogen. The *A. pyogenes* isolate used in this study was initially recovered from an abscess in a white-tailed deer at the Animal Diagnostic Laboratory at The Pennsylvania State University. Identification was based upon phenotypic

characteristics and then confirmed by the Sensititre system (Trek Diagnostic System, Cleveland, OH, USA).

2.2. Vaccines

Ninety eight-week-old CF-1 female mice weighing 19-21 g were randomly divided into six groups of 15 mice each. Mice were allowed a one-week acclimation period prior to any experimental influence. Four of the groups received one of four different vaccine preparations (*F. varium* bacterin, *F. varium* toxoid, *F. necrophorum* bacterin, *F. necrophorum* toxoid). The autogenous bacterin vaccines containing *F. varium* or *F. necrophorum* were prepared by growing the culture in a tube containing Pre-reduced Anaerobically Sterilized (PRAS) Brucella broth for 24 h at 37°C in an anaerobic chamber. Subsequently, the culture was killed with 0.3% formalin and then placed on a shaker at 4°C for 24h; thus, leaving a suspension of dead cellular components for vaccination. The toxoid vaccines of *F. varium* or *F. necrophorum* were prepared in a similar fashion, including an additional step of centrifugation at 13,500 X g for 30 minutes at 4°C and sterile filtration of cellular components through a 0.22 µm membrane filter. Thus, the filtrate contained any inactivated toxins potentially secreted by the bacteria, but no bacterial structural components. All immunogens were emulsified with the Sigma Adjuvant System (Sigma Aldrich Co., St. Louis, MO, USA). The two control groups received sterile Brucella broth combined with the Sigma Adjuvant System. Each mouse was injected subcutaneously on the back of the neck on days 0 and 14 with 0.2 ml of one of the above preparations.

2.3. Challenge with F. varium and A. pyogenes

Prior to injection into mice, *F. varium* and *A. pyogenes* were grown to an OD_{600} of approximately 0.8 and 1.4, respectively, in separate PRAS Brain-Heart Infusion (PRAS BHI) broth. The culture of *F. varium* was diluted 2-fold with sterile Phosphate Buffered Saline (PBS). Similarly, the *A. pyogenes* culture was diluted 3-fold. The culture of *F. varium* and *A. pyogenes* had a bacterial concentration of 3.5×10^8 CFU/ml and 5.15×10^8 CFU/ml, respectively. The final CFU/ml concentrations were obtained via spread plating, for which dilutions of 10^{-6} through 10^{-8} were plated in duplicate onto sheep blood agar plates and incubated anaerobically at 37°C for 48 h; colonies were counted and averaged on plates yielding 30-300 colonies. The 0.2 ml of inoculum of *F. varium* and *A. pyogenes* had a bacterial concentration of approximately 7×10^7 CFU/mouse and 1.03×10^8 CFU/mouse, respectively. Subsequently, mice in the four treatment groups and the positive control group were injected intraperitoneally with a 0.2 ml dose of each of these cultures on day 28. Mice in the negative control group received a 0.2 ml dose of sterile PRAS BHI broth intraperitoneally. In order to record experimental end-points and mortalities, mice were observed twice daily for 14 days post-infection. Mice were euthanized upon reaching a surrogate endpoint defined by observations of labored respiration, loss of ability to ambulate, dehydration, and reduced body condition. Mice that survived for two weeks post-challenge were euthanized, necropsied, and observed for the presence of liver abscesses and peritonitis.

2.4. Blood cultures

Approximately 1 ml of heart blood from mice was collected during necropsy in a 3 ml syringe. One drop was injected into a tube containing 5 ml of sterile PRAS BHI broth, while the remaining blood was collected into a Microtainer tube (Becton Dickinson Co., Franklin Lakes, NJ, USA) for subsequent serum separation. PRAS BHI tubes with blood samples were

incubated in an anaerobic chamber at 37°C for 48 h. These samples were then streaked on sheep blood, Laked Sheep Blood Kanamycin Vancomycin (LKV), and Phenylethyl Alcohol (PEA) agar plates (Remel, Lenexa, KS, USA). Plates were incubated in anaerobic chamber at 37°C for 48 h. Suspected *F. varium* and *A. pyogenes* colonies were identified using known morphology, gram stain, and RapID ANA II and Sensititre system respectively according to manufacturer's instructions.

2.5. Liver cultures

At necropsy, approximately 1 g of liver from each mouse was collected into a Whirl-Pak (Nasco, Fort Atkinson, WI, USA) bag and homogenized by manually homogenizing the sample in 2 ml of PBS solution under aerobic conditions. Homogenate was then taken inside an anaerobic chamber and streaked onto sheep blood, LKV, and PEA agar plates. Plates were incubated at 37°C for 48 h. Suspected *F. varium* and *A. pyogenes* colonies were identified using known morphology, gram stain and RapID ANA II and Sensititre system respectively.

2.6 Statistical analysis

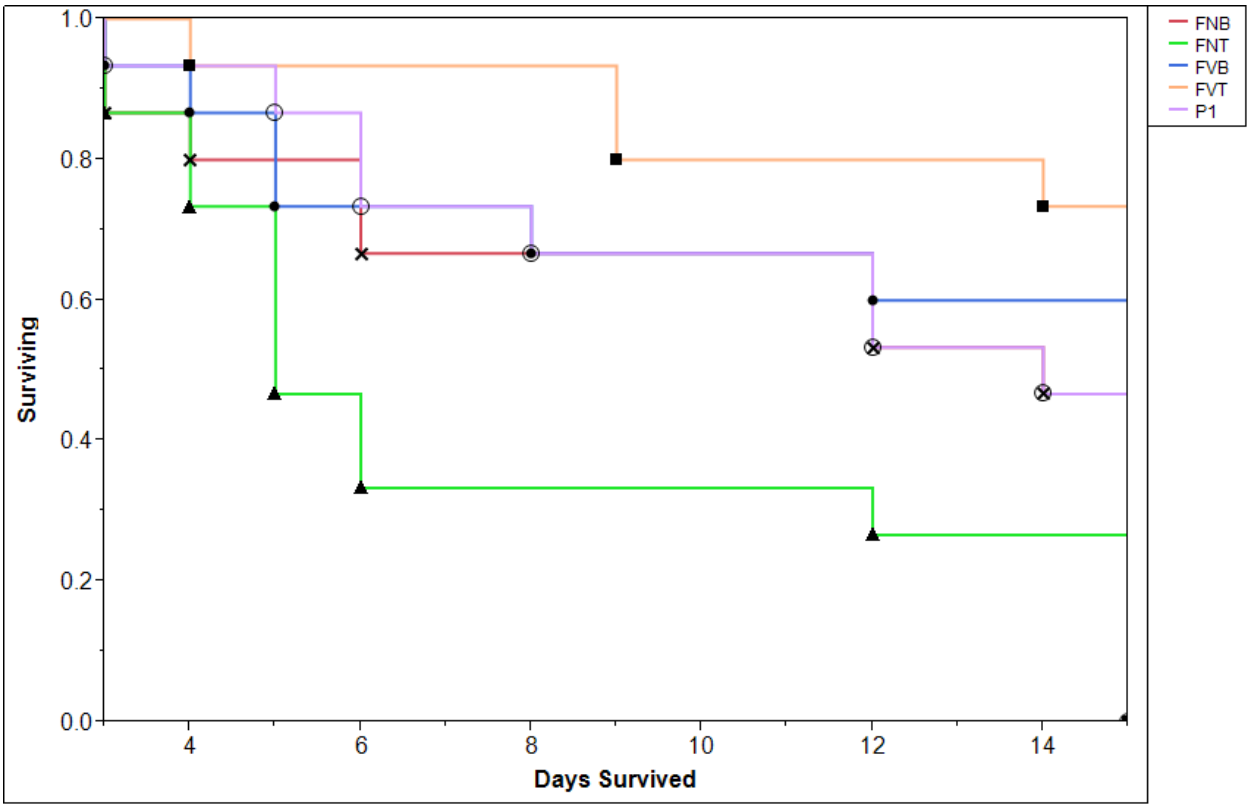
Bacterial identification, mortalities, liver abscess, and peritonitis data was evaluated by Pearson's chi-squared test. Mortalities were further evaluated via a survivability curve. Standard statistical software (JMP, Cary, NC, USA) was used. For all analyses, a value of $P < 0.05$ was considered significant.

3. Results

3.1. Survivability

Following the challenge with *F. varium* and *A. pyogenes*, with the exception of the negative-control, mice in all groups exhibited mortalities during the two-week period post-challenge. The survivability curve shown below depicts the percent of the total mice surviving on a particular day throughout the two-week period post-infection (Figure 1 and Table 1)

Figure 1: Survivability curve including the four vaccinated and positive control groups



3.2. Hepatic and peritoneal pathology

Of the 90 mice studied, 34 died prior to the two-week period post-challenge. Four out of 15 mice (27%) vaccinated with the *F. varium* bacterin developed either liver abscesses, peritonitis, or both. Two of the 15 mice (13%) that received the *F. varium* toxoid vaccine had either liver abscesses or peritonitis. Seven out of 15 mice (47%) vaccinated with the *F. necrophorum* bacterin developed either liver abscesses, peritonitis, or both. Six out of 15 mice (40%) that received the *F. necrophorum* toxoid vaccine had either liver abscesses or peritonitis; one mouse exhibited both conditions. 10 out of 15 mice (67%) in the positive control group developed liver abscesses, peritonitis, or both. None of the mice in the negative-control group died or developed gross lesions (Table 1).

Table 1. Mortality, liver abscess formation, and peritonitis presence of mice vaccinated with different preparations after experimental challenge with *Fusobacterium varium*

Vaccine Preparations/Infection	Number of dead mice	Number of mice with liver abscess (%)	Number of mice with peritonitis (%)
F. varium bacterin	6/15 (40)	3/15 (20)	3/15 (20)
F. varium toxoid	3/15 (20)	1/15 (6.7)	1/15 (6.7)
F. necrophorum bacterin	7/15 (47)	2/15 (13.3)	5/15 (33.3)
F. necrophorum toxoid	11/15 (73)	4/15 (26.7)	3/15 (20)
Positive Control (Sterile media)	7/15 (47)	7/15 (46.7)	3/15 (20)
Negative Control (Sterile media)	0/15 (0)	0/15 (0)	0/15 (0)

No significant differences were detected between treatment groups and the positive control group

3.3. Identification of F. varium and A. pyogenes in liver tissue and heart blood

F. varium and *A. pyogenes* were both isolated from homogenized liver tissue and heart blood from 33 out of 34 mice (97%) that died during the two-week period post-challenge. Of the 56 mice that survived this period, both *F. varium* and *A. pyogenes* were isolated from homogenized liver tissue from four mice (7%) and heart blood from one mouse (1.8%). Either *F. varium* or *A. pyogenes* was isolated from homogenized liver tissue from three mice (5%) and heart blood from one mouse (1.8%) (Table 2).

Table 2. Isolates of *F. varium* or *A. pyogenes* recovered from homogenized liver and heart blood samples

Vaccine Preparations/Infection	No. of liver samples		No. of heart blood samples	
	F. varium	***A. pyogenes***	***F. varium***	***A. pyogenes***
F. varium bacterin	$6/15^{a,b}$	$6/15^{a,b}$	$6/15^{a,b}$	$6/15^{a,b}$
F. varium toxoid	$3/15^{a}$	$3/15^{a}$	$3/15^{a}$	$3/15^{a}$
F. necrophorum bacteirn	$7/15^{a,b}$	$8/15^{a,b}$	$7/15^{a,b}$	$8/15^{a,b}$
F. necrophorum toxoid	$11/15^{b}$	$11/15^{b}$	$11/15^{b}$	$11/15^{b}$
Positive Control (Sterile media)	$9/15^{a,b}$	$7/15^{a,b}$	$7/15^{a,b}$	$7/15^{a,b}$
Negative Control (Sterile media)	$0/15^{c}$	$0/15^{c}$	$0/15^{c}$	$0/15^{c}$

Within a row, means that do not have the same superscript letters (a-c) differ (P<0.05).

4. Discussion

Multiple responses including mortality, presence of liver abscesses and peritonitis, and bacterial identification in liver and heart blood were considered to evaluate the effectiveness of

various vaccine preparations in providing protection against experimental co-infection with *F.* varium and *A. pyogenes*. The *F. varium* toxoid vaccine was an effective immunogen as evidenced by low mortalities (20%) and showed the least number of hepatic lesion and abdominal inflammation. Furthermore, bacterial presence in the livers and heart blood of mice from this group was the lowest relative to the other treatment groups.

The *F. necrophorum* toxoid vaccine was a poor immunogen resulting in 11 mortalities in this group after challenge with *F. varium* and *A. pyogenes*. Moreover, the number of deaths from this treatment group was significantly greater than even the positive control. These results suggest that some secreted factor had a negative influence on mice vaccinated with the *F. necrophorum* toxoid vaccine. It is possible that *F. necrophorum* leukotoxin, an endotoxin known to be secreted by *F. necrophorum,* caused the mice to succumb to endotoxic shock. As a result, the mice may have become more susceptible to infection in comparison to mice that received no vaccination.

In contrast, there is currently no evidence of leukotoxin gene or production in *F. varium*; therefore, the protective affects elicited by the *F. varium* toxoid vaccine may stem from alternate factors (Brooks et. al., 2013). For example, previous studies have identified butyric acid as a potential virulence factor in *F. varium* (Ohkusa et. al., 2003). Butyric acid has been identified to cause colonic lesions and host inflammatory responses by inducing apoptosis (Okayasu, 2012). Ultimately, this investigation suggests the presence of a secreted virulence factor, other than leukotoxin, within the *F. varium* toxoid vaccine.

Further studies are necessary in order to focus experiments on vaccines prepared with *F. varium*. This study provided information that suggests the current vaccine used by deer farmers may not be the most protective method against *F. varium* infection.

Acknowledgements

I would like to thank Dr. Jason Brooks of The Pennsylvania State University Department of Veterinary and Biomedical Sciences for allowing me to conduct this research in his laboratory. Thank you also to the Ronald E. McNair Scholars Program for granting me this research opportunity.

References

Potrykus J, White RL, Bearne SL. Proteomic investigation of amino acid catabolism in the indigenous gut anaerobe *Fusobacterium varium*. *Proteomics*. 2008;8:2691-2703.

Brooks JW, Jayarao BM, Kumar A, Narayanan S, Myers S, Nagaraja TG. Characterization of *Fusobacterium* isolates from the respiratory tract of white-tailed deer. Submitted to *Veterinary Research*, July 2013.

Adler, J., Chakera, T. M., & Thompson, R. (1990). Necrobacillosis. *Australasian Radiology, 34*(3), 256-259. doi:10.1111/j.1440-1673.1990.tb02644.x

Brooks JW, Jayarao BM. *A comprehensive study of the health of farm-raised white-tailed deer (Odocoileus virginianus) with emphasis on respiratory tract infection by Fusobacterium spp.* University Park, Pa.: Pennsylvania State University; 2010.

Legaria MC, Lumelsky G, Rodriguez V, Rosetti S. Clindamycin-resistant *Fusobacterium varium* bacteremia and decubitus ulcer infection. *Journal of Clinical Microbiology*. 2005;43:4293-4295.

Hattel AL, Shaw DP, Love BC, Wagner DC, Drake TR, Brooks JW. A Retrospective Study of Mortality in Pennsylvania Captive White-Tailed Deer (Odocoileus virginianus): 2000-2003. *Journal of Veterinary Diagnostic Investigation*. 2004;16:515-521.

Pennsylvania Deer Farmers Association. The economic impact of Pennsylvania's deer farms: Pennsylvania Deer Farmers Association, Nov 2006.

United States Department of Agriculture NASS. 2007 Census of Agriculture, Dec 2009.

Narayanan SK, Chengappa MM, Stewart GC, Nagaraja TG. Immunogenicity and protective effects of truncated recombinant leukotoxin proteins of *Fusobacterium necrophorum* in mice. *Veterinary Microbiology*. 2003;93:335-347.

Tan ZL, Nagaraja TG, Chengappa MM. *Fusobacterium necrophorum* infections: virulence factors, pathogenic mechanism and control measures. *Veterinary Research Communications*. 1996;20:113-140.

Mass S. *The Immune Responses of Mice and Cattle to Fusobacterium necrophorum (Necrobacillosis, Foot Rot, Liver Abscess).* ProQuest, UMI Dissertations Publishing; 1986.

Ohkusa, T., Okayasu, I., Ogihara, T., Morita, K., Ogawa, M., Sato, N., 2003. Induction of experimental ulcerative colitis by *Fusobacterium varium* isolated from colonic mucosa of patients with ulcerative colitis. *Gut* 52, 79-83.

Okayasu, I., 2012. Development of ulcerative colitis and its associated colorectal neoplasia as a model of the organ-specific chronic inflammation-carcinoma sequence. *Pathology International* 62, 368-380.

African Americans at PWIs: The Role of Race Consciousness and Ethnic Identity in Predicting Mental Health

Charles Lawson, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Jose Soto, Ph.D.
Associate Professor of Psychology
Department of Psychology
College of Liberal Arts
The Pennsylvania State University

Abstract

African American students continue to be underrepresented at many American colleges and universities. These institutions are referred to as Predominantly White Institutions (PWIs). Some research suggests that the racial environment at PWIs negatively impacts the mental health (depression and anxiety) of African Americans. However, few studies consider how internal racial factors such as racial centrality and race consciousness (how often race is thought about) relate to mental health in a PWI context. This study investigates this question among 71 African American students at a PWI who completed questionnaires about their racial identity and mental health. Regression analysis indicated that centrality and race consciousness were not related to mental health outcomes. However, post hoc analyses revealed an interaction between race consciousness and private regard in predicting depression. Therefore, researchers and higher education administrators should consider both internal and external racial variables in understanding the mental health of African American college students.

Introduction

Historically, African Americans have been underrepresented at institutions of higher education in the United States. In fact, the majority of African American students attend institutions of higher learning where the racial/ethnic composition of the students, faculty, and staff is predominantly white (Predominantly White Institution [PWI]; Douglas, 1999). This environment may contrast sharply with the communities that many African American students may come from, where their cultural identity is more visibly represented. While the transition from high school to college creates stress for all freshman students, African American students may experience this transition as more stressful because of the differences in racial environment and the experiences that might coincide with this change (e.g., isolation, discrimination, and racism).

According to several researchers such as Harwood et. al (2012), African American students at describe their experiences as unwelcoming and unsupportive because of overt and

covert forms of racism. Earlier this year, Oberlin College in Ohio cancelled classes for a day after a student reported seeing a person resembling a Ku Klux Klan member near an African heritage house. This incident followed other recent hate incidents that occurred at the college which included posters with racial slurs written on them and other derogatory statements targeting various student communities around campus (Cable News Network, 2012). These events reinforce findings that some African Americans experience hostile peer communication (e.g. racist jokes, comments, racial slurs) at PWIs (Harwood et. Al, 2012, Solórzano et. al, 2001). Such unique experiences are associated with many adverse outcomes such as low academic performance, higher levels of stress, mental health problems and even withdrawal from college (Harwood et. al, 2012). As further evidence of the deleterious effects of a negative racial environment, recent data demonstrates that the gap in attrition rates between African American and White college students (with the former having higher rates; Guiffrida & Douthit, 2010) becomes even larger when focusing solely on predominantly white institutions (Bowen & Bok, 1998).

Environmental Variables

A significant body of research has demonstrated that the environment at predominantly white institutions strongly impacts African American students' college experience. Many of these students may be first-generation college students, who have never been exposed to a predominantly white environment. Although many PWIs have become more diverse, African American students at PWIs may frequently experience racism. The term *racial microagressions* refers to subtle and hidden forms of discrimination. In their investigation of racial microagressions at a PWI, Harwood et al. (2012) conducted focus groups with students of color about their college experiences. Many students reported racist jokes and comments, racial slurs, and overall unequal treatment. For example, one student reported her roommate was "constantly saying little comments." Another student noted the appearance of segregation in the residence halls reporting that certain halls were being referred to as "minority central" or "the projects" (Harwood, 2012). Similar to Harwood et al., Solorzano & Yosso (2001) also examined racial microaggressions and the experiences of African American college students. Many students reported similar overt and covert forms of racism.

Loo and Rolison (2012) investigated feelings of alienation among minority students in relation to their environment and found that African American students in a PWI experience more feelings of alienation than white students. If African American students do not feel welcomed or if they experience any kind of racial discrimination, they are more likely to drop out of that particular institution (Gloria et al., 1999). Consistently, many prior studies have found that African American students perceive their general campus climate more negatively than their white peers do (Reid & Radhakrishnan, 2003) Moreover, Gloria et al (1999) researched the influence of social support and university comfort on African American students' persistence decisions (i.e. decisions concerned with staying in school). Consistent with the existing literature on the significant role of institutional climate, higher levels of social support and more comfort in the university environment were associated with more positive academic persistence decisions (i.e., students staying in school). Thus, a number of studies have established the significant role of environmental variables, such as the racial make-up of the school (i.e., PWIs) in the college experience of African Americans. However, less research has

considered how individual differences in internal racial processes might affect African American students' adjustment to attending a PWI.

Internal Variables

In much of the research examining the impact of the experiences of African American students at PWIs on their psychological well-being, it is implicitly assumed that African American students experience feelings of alienation due to an incongruence between their own cultural values and beliefs and those of the PWI. However, less research has actually concentrated on African American students' individual beliefs regarding race in relation to their psychological well-being and their own racial identity.

Minority students often face unique challenges regarding the meaning of their racial identity which may represent threats to their identity (Chavous, 2000). How each individual reacts to these challenges can lead to important individual differences that influence how his/her college environment affects him/her. Perceptions of college environments vary among African American students, and these individual differences are important to their college experiences. Thompson, Anderson, and Bakeman (2000) examined the effects of racial socialization and racial identity on acculturative stress and found that certain racial identity attitudes were associated with higher levels of acculturative stress. Individuals who had more Pre-encounter or Immersion attitudes tended to experience more acculturative stress. Individuals with Pre-encounter attitudes may be dealing with self-acceptance or anxiety related to being an African American while those holding immersion attitudes almost exclusively affiliate themselves with Black culture. Similarly, Lee and Ahn (2013) found different racial identity attitudes to be associated with different levels of discrimination and psychological distress. Pre-encounter attitudes were significantly related to psychological distress. Acknowledging the importance of perception and racial identity, this current study focuses on how certain aspects of racial identity interact to influence mental health. Specifically, we investigate the relationship between racial centrality and mental health.

Ethnic Identity. Ethnic identity has been one of the most heavily researched areas regarding the psychological experiences of African Americans. The experiences of African Americans differ from one individual to another. The significance and qualitative meaning that is attributed to being a member of the black racial group varies among African Americans. For example, some may place little significance on their race in defining themselves, while others may feel their race is a strong part of their identity. Even at similarly high levels of significance on race, individuals may differ in their meaning of what it means to be an African American (Sellers et al., 1998). Because of these many differences, understanding the significance of race in the experiences of African Americans is difficult. In this study, ethnic identity will be operationalized and evaluated using the Multidimensional Inventory of Black Identity (MIBI) which defines racial identity as part of a person's self-concept related being an African American. The MIBI consists of three subscales: *Regard*, *Ideology*, and *Centrality*. The regard dimension refers to an individual's judgment of his or her race in terms of feelings of positivity or negativity. Simply put, regard refers to how positive an individual feels about his or her race. Regard consists of both a private and public component. *Private regard* refers to how positively an individual feels toward his or her race as well as how positively an individual feels about

being a member of their race. *Public regard* refers to how individuals feel others view their race. It can be thought of as an individual's assessment of how his or her group is viewed by the rest of society.

Ideology refers to an individual's beliefs and opinions in regards to the how he or she feels member of his or her race should act. It is an individuals' philosophy about the ways his or her race should live and interact with the rest of society (Sellers et al, 1998). The ideology dimension is compromised of four ideological philosophies: a *nationalist* philosophy, an *oppressed minority* philosophy, an *assimilation* philosophy, and a *humanist* philosophy.

Centrality, one of our variables of interest, refers to the extent to which a person normally defines himself or herself with regard to race. It is a measure of whether race is a core part of an individual. Centrality is concerned with the significance of race in an individual's self-concept (Sellers et al, 1997). For instance, some African American women define themselves more by gender than by race while others may use race as a more essential self-defining characteristic (Sellers et al, 1998). What lies in one's beliefs and attitudes regarding race is very essential and an ample amount of research suggest this is a major factor in social, mental, and academic outcomes. Sellers et al. (1998) explored the relationship between racial ideology, racial centrality, and academic outcomes. Both racial ideology and racial centrality were significantly related to students' cumulative GPA. In addition, racial centrality appeared to moderate the relationship between racial ideology and academic performance.

Varying levels of racial centrality may also impact African American students differently. Chavous (2000) suggested that racial centrality may play a protective role in African American students' feelings of social fit. She explored the relationship between African American students' perceptions of their college environment and their beliefs regarding race (racial ideology and racial centrality). Racial centrality was related to students' perceived environmental fit and organizational involvement. Thus, it would follow that centrality may be related to how African American students are adjusting to their new environment. The model we propose for the present study involves investigating the relationship between African American students' levels of racial centrality and mental health outcomes.

Race Consciousness. Some students may notice the racial differences of the environment at a PWI while others may be completely obvious to such differences. This awareness or consciousness of race varies among African American college students and thus affects each student differently. Race Consciousness refers to the extent that an individual thinks about race. It is measured via the question, "How often do you think about race?" It is similar to the concept of racial salience in that both concepts deal with how prominent a role is given to race by the individual. Racial salience is concerned with the relevance of race to one's self concept, and individual differences in racial salience become more evident in more ambiguous situations (Sellers et al., 1998). However, while racial salience refers to the importance of race in a particular moment or situation, race consciousness refers to thoughts about race on a normal basis. As previously mentioned, African American students may differ in how they define themselves. Levels of race consciousness may also vary between students leading to many different outcomes and perceptions among African American students. The present study

proposes that race consciousness may play a mediating or moderating role between racial centrality and mental health outcomes.

African American Students and Mental Health Outcomes

African American students attending PWIs may be more susceptible to negative psychological adjustment as a result of the added minority stress associated with the adjustment to what is often a new and different racial environment (Wei et al. 2010). Wei et al. examined the effects of perceived bicultural competence (PBC) and minority stress on depressive symptoms (2010). Based on LaFromboise's Biculturalism Theory, PBC was defined as being able to "live effectively, and in a satisfying manner, within two groups without compromising one's sense of cultural identity." For example, minority students often need to interact with people from the majority culture as well as their own culture (Wei et al., 2010). Minority stress was found to be positively associated with depressive symptoms while PBC was found to be negatively associated with depressive symptoms. In other words, students' sense of confidence in their abilities to function well in not only their own culture, but in another culture as well was related to higher psychological well-being. In another study, Mendoza-Denton et al. (2002) examined African American students' expectations of being accepted or rejected on the basis of their minority status. Students high in race rejection sensitivity (RS-race) showed greater discomfort and less trust in the university negatively affecting their social relationships and psychological well-being.

Research has also found links between different aspects of racial identity and psychological symptoms. Neblett, Jr. et al. (2013) investigated the relationship between ethnic-racial socialization and the psychological adjustment of African American students. Racial identity (specifically, private regard attitudes or positive feelings about being African American) was found to act as a mediator in the relationship between ethnic-racial socialization behaviors and adjustment. In another study, Smedley et. al (1993) examined the relationship between minority status stress and the psychological adjustment of minority freshman. Minority status stress negatively impacted students negatively affecting their confidence and sense of belonging to the university. The impact was even greater for African American students. Further, Pillay (2005) examined unique relationship between racial identity and psychological health in African American students attending PWIs. Racial identity, specifically the Pre-Encounter and Encounter stages, was found to be negatively related to psychological health. Although outcomes such as higher attrition rates are very important, those outcomes are more distal, and more proximal outcomes such as mental health symptoms (e.g. mood and depression) need to be analyzed. Proximal factors are important to understand because of the possibility of earlier intervention. For this reason, we examine how differences in racial identity among African American students and how those differences influence mood (depression) and anxiety at a PWI. If more proximal outcomes such as anxiety and depression can be managed, more distal outcomes such as dropping out may be reduced.

The Present Study

In order to better understand the college experience of African American students attending PWIs, the present study aims to investigate the relationship between different internal racial variables and mental health outcomes among African American students at PWIs. In particular, this study will examine the relationship between *Racial Centrality, Race Consciousness,* and mental health as measured by anxiety and depression symptoms. We examine the effects of race consciousness by proposing two different models relating the three variables. First, we examine race consciousness as a *mediator* between racial centrality and mental health symptoms. Second, we examine race consciousness as a *moderator* between racial centrality and mental health symptoms.

In our first mediator model, we predicted that race consciousness would act as a mediator between racial centrality and mental health. First, we expected racial centrality to be correlated with depression/anxiety. Specifically, it was expected that students with higher levels of racial centrality would experience more symptoms of depression and/or anxiety. Next, we hypothesized that race consciousness would mediate this relationship. African American students with higher levels of racial centrality may be more likely to notice the racial differences and think about them more often if being African American is a central part of their identity. Consequently, this may lead to more feelings of alienation which may also lead to higher levels of depression and/or anxiety within the student.

We also investigated the role of race consciousness as a moderator between racial centrality, and depression and anxiety. Specifically, we expected those with higher levels of race consciousness to experience more depressive and anxious symptoms. We believe these students, especially those with higher levels of centrality, will be more likely to take note of the racial differences around campus thus leading to more depressive/anxious symptoms. On the other hand, we expect those with lower levels of race consciousness to experience fewer depressive and anxious symptoms. We predict this will be especially true of those students with lower levels of centrality.

Methods

Participants

Participants for the present study were 71 African American college students at a large, predominantly White university in the mid-Atlantic region of the United States. Participants were recruited through a participant pool run through the department of psychology and from the general college population. Participants were either given course credit (participant pool) or $10 in compensation (non-participant pool). Only participants who were current freshman or sophomores were eligible for participation. The final sample consisted of 33freshmen (46.5%) and 38 sophomores (53.5 %) and included 52 women (73.2%) and 19 men (26.8%). The age of participants ranged from 18 to 21 with a mean age of 18.85 years (SD= .73).

Measures

Demographics Questionnaire. Participants completed a demographics questionnaire asking about their age, gender household composition, head of the household (and their highest grade completed), and family income. Family income was reported using a 1-5 scale where 1=$0-15K, 2= $15-30k, 3= $30-45K, 4= $45-60K, 5= $60-75K, and 6= $75K or higher.

Race Consciousness. One item from the Behavioral Risk Factor Surveillance System (BRFSS) was used to measure race consciousness. The BRFSS is a questionnaire typically used to collect data about health-related risk behaviors and chronic conditions. This question asked "How often do you think about your race?" and used an 8-point scale ranging from 1 (Never) to 8 (Don't know/Not sure).

Racial Centrality. The Multidimensional Inventory of Black Identity (MIBI) was used to measure racial centrality. The MIBI consists of 7 subscales representing 3 dimensions of African American racial identity (Centrality, Ideology, and Regard). Our primary hypothesis focused on the Centrality subscale. This subscale is comprised of 8 items asking about the importance of race, which are rated on a Likert-type scale from 1 (strongly disagree) to 7 (strongly agree). Items include statements such as, "My destiny is tied to the destiny of other African-Americans." and, "I have a strong sense of belonging to African-Americans." Past research using this subscale has established sufficient reliability indexes ranging from .75 to .83 (Sellers, 1998).

Mental Health. The Brief Symptom Inventory-18 was used to measure the presence of symptoms of depression, anxiety, and somatization. This inventory consists of 18 items on which participants rated their level of distress over the past week using a 5-point scale ranging from 0 (not at all) to 4 (extremely). For the purposes of the present study, only the depression and anxiety subscales were used. Examples of items on the depression subscale include asking about symptoms such as "Feeling hopeless about the future" and "feelings of worthlessness". Examples of items on the anxiety subscale include symptoms such as "nervousness or shakiness inside" and "trouble getting your breath".

Procedure

Data for this study were taken from a larger data set examining the effect of environmental transitions on mental health. Participants completed an online survey that included the measures described above along with additional measures of GPA, health risk behaviors, and perception of campus racial climate. For the present study, we were only interested in the mental health outcomes and therefore limited our presentation and discussion to those measures relevant to our research question as well as data necessary for participant selection (BSI, MIBI, and Demographics questionnaire).

Results

Bivariate Correlations

The first step in our analyses was to conduct bivariate correlations between the primary variables of interest (see Table 1). Race consciousness was not significantly related to depression ($r= .097$, $p>.05$) or anxiety ($r= .055$, $p>.05$). Similarly, centrality was also not significantly related to depression ($r= -.089$, $p>.05$) or anxiety ($r= -.036$, $p>.05$). Although these variables were not significantly related, it is possible that race consciousness could still moderate the relation between centrality and mental health. However, in order for race consciousness to be a possible mediator between centrality and mental health, race consciousness would have to be related to mental health and to centrality. Because these requirements of mediation were not met we did not need to formally test for a mediation effect and were able to rule out this type of relationship.

Moderation Analyses

As previously mentioned, none of our variables were found to be correlated. However, it is still possible to have a moderation effect. To test for an interaction, we first centered race consciousness and racial centrality. Next, we computed an interaction term that consisted of the product of the centered variables. Finally, a hierarchal regression was run with depression as our outcome variable and race consciousness and centrality as the first predictors in the model (step 1) and the consciousness X centrality interaction as the second step in the model. An identical analysis was carried out with anxiety as the outcome variable. Our findings failed to reveal a significant main effect of race consciousness or centrality on depression or anxiety, nor was there a significant interaction between these variables in predicting depression or anxiety.

Post Hoc Analyses

The results obtained suggest that racial identity may not be meaningfully related to mental health among students at a PWI. However, it is also possible that the results are specific to the centrality subscale of the MIBI identity measure. Therefore, we decided to run analyses using the dimension of private regard in place of centrality. First, bivariate correlations were run to determine the correlation between private regard and mental health (anxiety and depression). No significant relationships were found to exist between any of the variables eliminating the possibility of a mediation effect.

However, even without any significant relationships among the zero-order correlations it is possible to have a significant interaction between centrality and race consciousness. Thus, we proceeded with our test of race consciousness as a moderator between racial centrality and mental health. First, race consciousness and private regard were centered. Next, we computed an interaction term that consisted of the product of the centered variables. Next, a hierarchal regression was run with depression as our outcome variable and race consciousness and private regard as the first predictors in the model (step 1) and the consciousness X private regard interaction as the second step in the model. An identical analysis was carried out with anxiety as the outcome variable. Our findings revealed a significant interaction between race consciousness,

private regard, and depression. Students who thought about their race more often reported less depressive symptoms the more they felt positively about their race (higher positive regard). For students that did not think about race as often, feeling more positively about their race was associated with more symptoms of depression.

Discussion

The primary goal of this study was to examine how different aspects of racial/ethnic identity interact to influence mental health in African American students attending a Predominantly White Institution (PWI). Specifically, we were interested in how race consciousness, centrality, and mental health (anxiety and depression) interacted to affect African American students. Although our initial hypotheses of mediation and moderation were not supported, a post-hoc analysis did reveal a significant interaction between race consciousness, private regard, and depression.

Our initial findings did not support our hypotheses and no significant relationships were found among our primary variables of interest, racial centrality, race consciousness, and depression/anxiety. Most notably, there was no relationship between centrality and depression or anxiety or between centrality and race consciousness This finding is similar to those found in a study conducted by Rowley et al. (1998) where centrality was found not be to significantly related to personal self-esteem (PSE). Strongly identifying with one's race does not necessarily lead to positive feelings about one's race and a lack of identification with one's race does not necessarily lead to negative feelings. Further, previous research has shown that different stages of racial identity and differences in racial socialization are associated with different levels of psychological stress (Thompson et al., 2000; Johnson & Arbona, 2006; Lee & Ahn, 2013). Thus, it is possible that within the current sample students may have expected and prepared themselves for this racial environment thereby overshadowing the possible effect of racial centrality and/or level of race consciousness. In fact it may be quite likely that African American students who decide to attend a PWI may be fully aware of the low diversity and racial disparities of the institution thus having a fair warning about what to expect should they decide to attend the institution. Sellers and Shelton (2003) found that students who expected others to view African Americans negatively did not experience as much distress when perceiving discrimination because this experience aligned with their worldview.

Moreover, with such possible expectations in mind, students may emphasize their focus on other important aspects of their college experience protecting themselves from the possible negative experiences of attending a PWI. Such students may ultimately do better at a PWI because they do not experience that discrepancy between their own expectations of attending a PWI and what is actually experienced once they start attending the institution. In addition, students with high levels of centrality may be aware of these racial differences and may notice other groups having similar experiences in terms of racial discrimination. Subsequently, these students may identify with those other racial groups thus buffering against the possible negative effects of a PWI. In support of this idea, Williams and Leonard (1998) reported that 81% of a sample of African American students identified with other racial groups based on racial identity views. Finally, it is possible that within the current sample many students may have come from

areas similar to the environment of a PWI thus buffering some of the negative effects (Dawson-Andoh, Soto, & Witherspoon, 2013).

Private Regard

Our post hoc analyses indicated a significant relationship between race consciousness, private regard, and depression. Specifically, our analyses revealed a significant interaction between private regard and depression. Students high in race consciousness felt less depressive symptoms the more they felt positively about their race. This finding is consistent with Lee and Ahn's (2013) findings which found private regard to be negatively associated with psychological distress. For students that did not think about race as often, feeling more positively about their race was associated with more symptoms of depression. One possibility is that students may be experiencing some societal or interpersonal pressure leading them to suppress thoughts about their race which in turn can lead to the expression of more depressive symptoms. Students may be suppressing their thoughts about race in order to fit in the environment of the PWI. In order to protect against possible distress, students may be actively not thinking about race and instead focusing on other aspects of their college experience.

Limitations and Future Directions

Several limitations are worth noting. First, our study only consisted of students from the general campus population and the subject pool, thus lacking a clinical population. This may have limited the variability in symptoms of depression or anxiety making it more difficult to find a relationship between mental health and our other variables of interest. An additional limitation lies in the measurement of our variable, race consciousness. Race consciousness was measured only by one item ("How often do you think about you race?"). This one question may not be a valid measurement of race consciousness and may not accurately capture this concept. Developing more items to assess this concept may result in a more accurate representation of students' race consciousness. Furthermore, we only examined freshmen and sophomore students leading us to question whether the impact of being at a PWI becomes more positive or more negative the longer students are there. Longitudinal studies of African American students where they can be followed throughout college or even starting from high school may allow us to gain a better understanding of the African American college experience. Finally, we did not examine the nature of participants' previous racial environments. Some participants may come from communities or neighborhoods where their race is the majority while other participants may come from predominantly white areas. Transitioning from these different communities and neighborhoods may reduce or aggravate the impact of attending a PWI (Dawson-Andoh, Soto, & Witherspoon, 2013).

Conclusion

This study contributes to the growing number of studies seeking to understand the role that individual racial variables play in influencing mental health at PWIs. We demonstrate that the college experiences of African American students at PWIs may differ depending on the way in which each individual thinks about their race. Understanding how various ethnic identity factors may interact to influence mental health can be helpful to those concerned with helping

these students adjust to attending a PWI. Given that African American students generally perceive their campus environment more negatively than their white peers (Reid & Radhakrishnan, 2003; Harwood et al., 2012), understanding the experiences of African American students is crucial. Therefore, it is essential that researchers gain a better understanding of the unique individual characteristics of African American students and how these different characteristics interact to influence mental health outcomes at PWIs.

References

Bowen, W. G., & Bok, D. (2002). The shape of the river. () Blackwell Publishing. Retrieved from http://search.proquest.com/docview/37864890?accountid=13158

Chavous, T. M. (2000). The relationships among racial identity, perceived ethnic fit, and organizational involvement for african american students at a predominantly white university. *Journal of Black Psychology, 26*(1), 79-100. Retrieved from http://search.proquest.com/docview/619519389?accountid=13158

Cokley, K. O., & Chapman, C. (2008). The roles of ethnic identity, anti-white attitudes, and academic self-concept in african american student achievement. *Social Psychology of Education, 11*(4), 349-365. doi:http://dx.doi.org/10.1007/s11218-008-9060-4

Dawson-Andoh, N., Soto, J., & Witherspoon, D. (2013). *An Ecological Approach to Racial Environments and their Relationship to Mental Health.* Manuscript submitted for publication.

Douglas, K. B. (1998). Impressions: African american first-year students' perceptions of a predominantly white university. *Journal of Negro Education, 67*(4), 416-431. Retrieved from http://search.proquest.com/docview/619520577?accountid=13158

Gloria, A. M., Kurpius, S. E. R., Hamilton, K. D., & Willson, M. S. (1999). African american students' persistence at a predominantly white university: Influence of social support, university comfort, and self-beliefs. *Journal of College Student Development, 40*(3), 257-268. Retrieved from http://search.proquest.com/docview/619405645?accountid=13158

Griffin, K., & Allen, W. (2006). Mo'money, mo'problems? high-achieving black high school students' experiences with resources, racial climate, and resilience. *Journal of Negro Education, 75*(3), 478-494. Retrieved from http://search.proquest.com/docview/621561297?accountid=13158

Guiffrida, D. A., & Douthit, K. Z. (2010). The black student experience at predominantly white colleges: Implications for school and college counselors. *Journal of Counseling & Development, 88*(3), 311-318. doi:http://dx.doi.org/10.1002/j.1556-6678.2010.tb00027.x

Harwood, S. A., Huntt, M. B., Mendenhall, R., & Lewis, J. A. (2012). Racial microaggressions in the residence halls: Experiences of students of color at a predominantly white university. *Journal of Diversity in Higher Education, 5*(3), 159-173. doi:http://dx.doi.org/10.1037/a0028956

Hurd, N. M., Sellers, R. M., Cogburn, C. D., Butler-Barnes, S., & Zimmerman, M. A. (2013). Racial identity and depressive symptoms among black emerging adults: The moderating effects of neighborhood racial composition. *Developmental Psychology, 49*(5), 938-950. doi:http://dx.doi.org/10.1037/a0028826

Johnson, S. C., & Arbona, C. (2006). The relation of ethnic identity, racial identity, and race-related stress among african american college students. *Journal of College Student Development, 47*(5), 495-507. doi:http://dx.doi.org/10.1353/csd.2006.0057

Lee, D. L., & Ahn, S. (2013). The relation of racial identity, ethnic identity, and racial socialization to discrimination–distress: A meta-analysis of black americans. *Journal of Counseling Psychology, 60*(1), 1-14. doi:http://dx.doi.org/10.1037/a0031275

Loo, C. M., & Rolison, G. (1986). Alienation of ethnic minority students at a predominantly white university. *Journal of Higher Education, 57*(1), 58-77. Retrieved from http://search.proquest.com/docview/617230244?accountid=13158

Ly, Laura. (2013). *Oberlin College cancels classes to address racial incidents* Retrieved from http://www.cnn.com/2013/03/04/us/ohio-oberlin-hate-incidents

Mattison, E., & Aber, M. S. (2007). Closing the achievement gap: The association of racial climate with achievement and behavioral outcomes. *American Journal of Community Psychology, 40*(1-2), 1-12. doi:http://dx.doi.org/10.1007/s10464-007-9128-x

Mendoza-Denton, R., Downey, G., Purdie, V. J., Davis, A., & Pietrzak, J. (2002). Sensitivity to status-based rejection: Implications for african american students' college experience. *Journal of Personality and Social Psychology, 83*(4), 896-918. doi:http://dx.doi.org/10.1037/0022-3514.83.4.896

Neblett, E. W., Jr., Banks, K. H., Cooper, S. M., & Smalls-Glover, C. (2013). Racial identity mediates the association between ethnic-racial socialization and depressive symptoms. *Cultural Diversity and Ethnic Minority Psychology, 19*(2), 200-207. doi:http://dx.doi.org/10.1037/a0032205

Pillay, Y. (2005). Racial identity as a predictor of the psychological health of african american students at a predominantly white university. *Journal of Black Psychology, 31*(1), 46-66. doi:http://dx.doi.org/10.1177/0095798404268282

Reid, L. D., & Radhakrishnan, P. (2003). Race matters: The relation between race and general campus climate. *Cultural Diversity and Ethnic Minority Psychology, 9*(3), 263-275. doi:http://dx.doi.org/10.1037/1099-9809.9.3.263

Sellers, R. M., Chavous, T. M., & Cooke, D. Y. (1998). Racial ideology and racial centrality as predictors of african american college students' academic performance. *Journal of Black Psychology, 24*(1), 8-27. Retrieved from http://search.proquest.com/docview/619190309?accountid=13158

Sellers, R. M., Rowley, S. A. J., Chavous, T. M., Shelton, J. N., & Smith, M. A. (1997). Multidimensional inventory of black identity: A preliminary investigation of reliability and construct validity. *Journal of Personality and Social Psychology, 73*(4), 805-815. doi:http://dx.doi.org/10.1037/0022-3514.73.4.805

Sellers, R. M., & Shelton, J. N. (2003). The role of racial identity in perceived racial discrimination. *Journal of Personality and Social Psychology, 84*(5), 1079-1092. doi:http://dx.doi.org/10.1037/0022-3514.84.5.1079

Sellers, R. M., Smith, M. A., Shelton, J. N., Rowley, S. A. J., & Chavous, T. M. (1998). Multidimensional model of racial identity: A reconceptualization of african american racial identity. *Personality and Social Psychology Review, 2*(1), 18-39. Retrieved from http://search.proquest.com/docview/619427379?accountid=13158

Smedley, B. D., Myers, H. F., & Harrell, S. P. (1993). Minority-status stresses and the college adjustment of ethnic minority freshmen. *The Journal of Higher Education, 64*(4), 434. Retrieved from http://search.proquest.com/docview/1296606785?accountid=13158

Solorzano, D., Ceja, M., & Yosso, T. (2000). Critical race theory, racial microaggressions, and campus racial climate: The experiences of african american college students. *Journal of Negro Education, 69*(1) Retrieved from http://search.proquest.com/docview/62248596?accountid=13158

Thompson, C. P., Anderson, L. P., & Bakeman, R. A. (2000). Effects of racial socialization and racial identity on acculturative stress in african american college students. *Cultural Diversity & Ethnic Minority Psychology, 6*(2), 196-210. Retrieved from http://search.proquest.com/docview/61671429?accountid=13158

Wei, M., Ku, T., & Liao, K. Y. (2011). Minority stress and college persistence attitudes among african american, asian american, and latino students: Perception of university environment as a mediator. *Cultural Diversity & Ethnic Minority Psychology, 17*(2), 195-203. doi:http://dx.doi.org/10.1037/a0023359

Wei, M., Liao, K. Y., Chao, R. C., Mallinckrodt, B., Tsai, P., & Botello-Zamarron, R. (2010). Minority stress, perceived bicultural competence, and depressive symptoms among ethnic minority college students. *Journal of Counseling Psychology,57*(4), 411-422. doi:http://dx.doi.org/10.1037/a0020790

Williams, T. M., & Leonard, M. M. (1988). Graduating black undergraduates: The step beyond retention. *Journal of College Student Development, 29*(1), 69-75. Retrieved from http://search.proquest.com/docview/617539744?accountid=13158

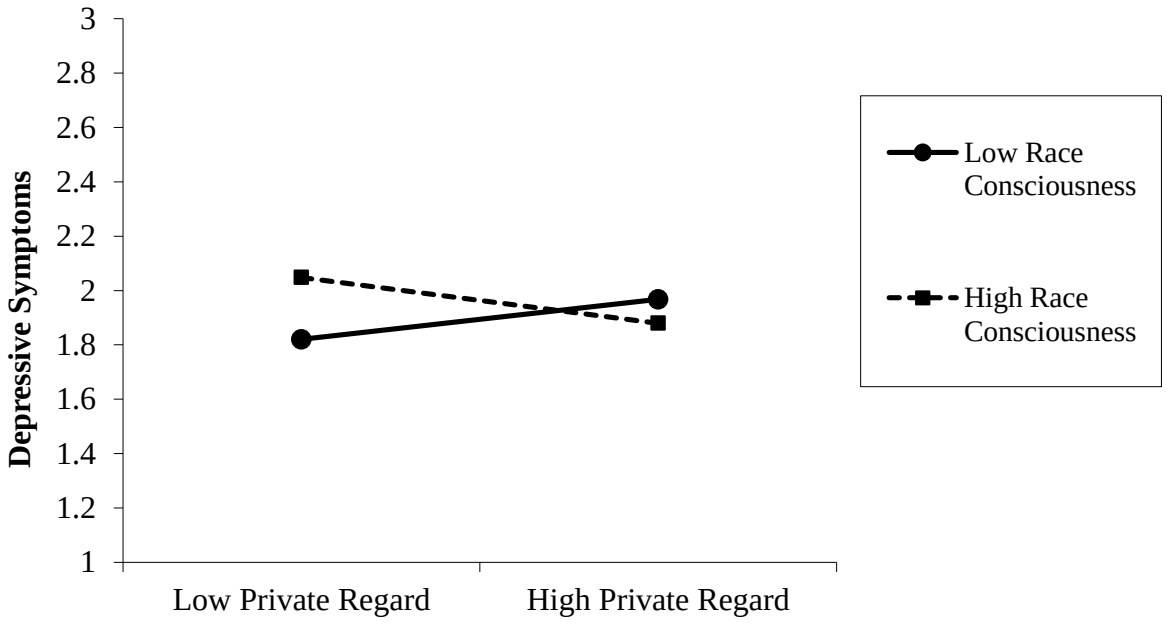
Table 1

Means, Standard Deviations, and Intercorrelations of Centrality, Race Consciousness, Anxiety, Depression, and Private Regard

Correlations	**Mean (SD)**	**1**	**2**	**3**	**4**	**5**
1. Centrality	3.91 (1.14)				-.036	-.089
2. Race Consciousness	4.79 (2.12)				.055	.097
3. Private Regard	5.48 (1.27)				-.037	-.029
4. Anxiety	1.59 (.71)	-.036	.055	-.037		
5. Depression	1.93 (.89)	-.089	.097	-.029		

***p< .05, **p< .01**

Figure 1. Relationship between Race Consciousness, Private Regard, and depressive symptoms



Exploring the relationship of participation and connectedness in afterschool programs to problem behavior

Rhoda K. Moise, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Emilie P. Smith, Ph.D.
Professor of Human Development and Family Studies
Department of Human Development and Family Studies
College of Health and Human Development
The Pennsylvania State University

Abstract

As a fairly new establishment for childcare, afterschool programs are understudied. However, some research proposes that these environments provide risk prevention for problem behavior. This research investigates the roles of attendance and connectedness in afterschool programs upon children's substance abuse and problem behavior. Multiple regression analysis was used among 22 programs to gauge correlations between participation, connectedness, and behavior. This data, collected from 282 students, will help determine how factors such as race, age, and/or gender interact with participation and connectedness to shape outcomes. Overall, this research explores whether participation and connectedness in afterschool serves as a beneficial public health strategy.

Introduction

Government expenditures on afterschool programs have dramatically increased over recent years. Additionally, this quickly growing segment of childcare has evolved from basic supervision to a more standardized form of education. Many individuals assume that enrollment in afterschool programs may deter students from partaking in problem behavior. However, few studies focus on participation and positive student outcomes. Demographics and program variation influence researchers' assessment of success and failure rates. For instance, differences in location shape factors such as the socioeconomic status and racial makeup of a program. Discrepancies between populations affect the uniformity of findings as seen in families in rural/agricultural communities compared to more affluent areas. As rural economic conditions worsen, parents experience more stress and children demonstrate higher rates of conduct problems and substance abuse (Conger & Elder, 1994; Riggs, 2006).

This research investigates afterschool programs for the purpose of exploring relationships between measures of students' attendance and connectedness to their afterschool program and the presence of four distinct behaviors: tobacco use, marijuana use, alcohol consumption, and delinquency. These findings will be analyzed using correlations and multiple regression analyses. The results of this research will potentially bring clarity to the current, yet limited research on this topic, as well as seek to combat the public health concern of emerging youth substance abuse.

The Rapid Evolution of Afterschool Programs

As a fairly new establishment for child care, afterschool programs require critical evaluation. Transformations in the American economy consequently altered the livelihood of children. During the 18th and 19th centuries, many Americans migrated from agrarian communities to find work in developing cities. The first after school programs appeared in the mid-late 1800s as purposeful safeguards imposed by elders to dissuade and preoccupy children growing up in immigrant neighborhoods in major cities from negative potential influences (Halpern, 2002). Afterschool programs quickly gained popularity due to the birth of the baby boomers in the 1950s and a substantial increase of women entering the workforce.

Afterschool programs are now the quickest growing child care sector to-date. Currently, 8.4 million K-12 children (15 percent) participate in afterschool programs; however, an additional 18.5 million would participate if a quality program were available in their community (Afterschool Alliance, 2013). The Afterschool Alliance election poll found that 92 percent of working mothers believe that afterschool programs are "very important" given that kids in supervised afterschool programs are less likely to engage in risky behaviors, such as criminal activity and drug or alcohol use.

Rationale for Research

Although some researchers disagree over their effectiveness, most communities believe there is a **need** for afterschool programs. Lengthy school day hours cause heavy strain as emphasis on academic work overshadows supplemental activities such as music, art, and physical education (Mahoney & Zigler, 2006). Afterschool programs provide a venue for other facets of learning which seems absent during the traditional six-hour school day. Furthermore, afterschool programs provide a unique opportunity to implement positive youth development (PYD) approaches, which teach substance use prevention skills along with participation in health education and cultural heritage activities (Tebes et al., 2007). We must capitalize on this educational space to implement prevention, which may ultimately serve as a Public Health tool against substance abuse in adolescence.

Previous studies suggest numerous positive effects of afterschool programs on youth. While research on the subject still remains limited, primary findings propose that adult regulated environments provide risk prevention for substance use and other problem behavior through developing personal and socials skills (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). Research from the Promising Afterschool Programs Study found that regular participation in high-quality afterschool programs is linked to significant gains in standardized test scores and work habits as well as reductions in behavior problems among disadvantaged students (The Afterschool Alliance, 2013). Furthermore, supervised structured settings are associated with enriched childhood attachment to school, academic excellence, communication skills, positive self-esteem, and identity (Belgrave et al., 2000; Durlak & Weissberg; 2007, Larson, 2000; Lerner, 2005).

Over the past few decades, federal funding for afterschool programs has climbed steadily. Education legislation played a major role in this expansion. For example, the 21st Century Community Learning Center program, authorized under Title X, Part I of the Elementary and Secondary Education Act, was a component of the Clinton administration's attempt to assist

families and communities to keep their children "safe and smart." The more recent "No Child Left Behind Act," (NCLB) of which the Bush administration was a proponent, encompasses similar ideals. These Centers strive to support school district's public schools which operate as community education centers concentrating on providing academic support, drug and violence deterrence programming, technology education, art, music, recreation, and character education (Gottfredson et al., 2004). The 21st Century Community Learning Centers received $200 million dollars from Congress in 1999; furthermore, their funding has increased annually. The most recent appropriation to the program which, supports the creation of community learning centers that provide academic enrichment opportunities during non-school hours for children, was allotted in 2012 and totaled at $1.1 billion (http://www.ed.gov/21stcclc). Though much money is spent on afterschool programs, there are still 30% of middle school and 4% of elementary school children unsupervised after the close of the six-hour school day (Afterschool Alliance, 2013).

With the exponential growth in funding for afterschool programs, society must continuously reevaluate their purpose and efficacy. An Afterschool Alliance election poll revealed that more than 3 in 4 voters say afterschool programs are "an absolute necessity" for their community. Even though the majority of society favors afterschool programs, we must consider reality: despite the logical appeal a program for youth may elicit and encompass, all afterschool programs do not guarantee effectiveness; moreover, the program may have more negative overall effects than positive (Capaldi 2009). Emerging research indicates that young people often learn to become deviant by interacting with deviant peers in settings such as therapy groups, alternative schools, boot camps, group homes, and juvenile justice facilities (Dishion, Dodge, and Lansford, 2006). In order to validate the benefits of an afterschool program, researchers, administrators, and child-related professionals must assume responsibility for proving there are some. This task consists of examining the effects of afterschool programs; challenges include overcoming small sample sizes, measuring relevant change, and threats to internal validity (Bender et al., 2011). Since federal funding and societal support will be more likely to endorse programs on the grounds of need *and* efficacy, we must consider how researchers have debated what constitutes an effective program.

Conceptual Framework: Effective Programming

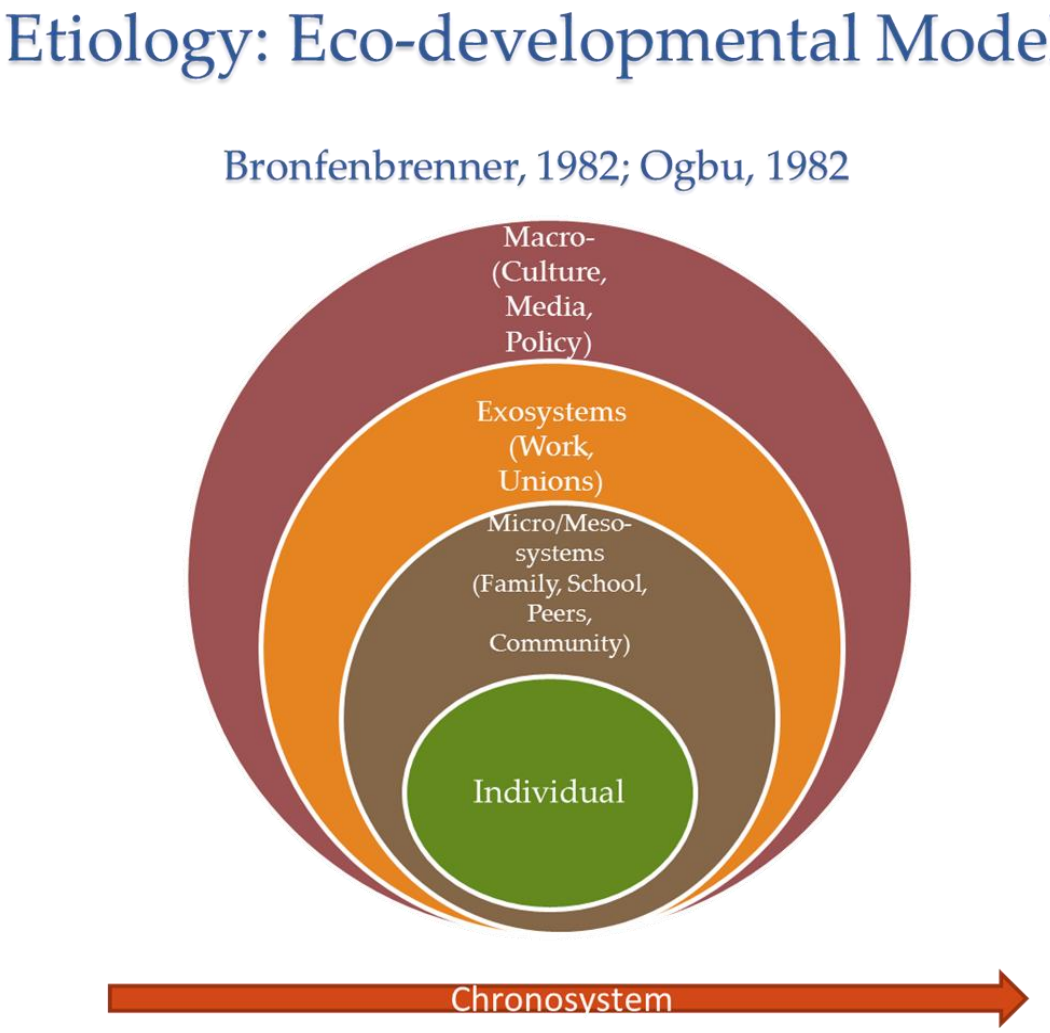
Researchers support the ideals of a program which utilizes social and emotional learning (SEL), a process for helping children and even adults develop the fundamental skills for life effectiveness, as well as teach the skills we all need to handle ourselves, our relationships, and our work, effectively and ethically (Graczvk & Weissberg, 2003). The proximal goals of SEL programs are to foster the development of five interrelated sets of cognitive, affective, and behavioral competencies: self-awareness, self-management, social awareness, relationship skills, and responsible decision making (Durlak et al., 2011). Durlak et al.'s meta-analysis synthesizes 213 studies of SEL programs for children in grades K-12 and illustrates how education stakeholders can promote healthy development of children by advocating for the incorporation of evidence-based SEL programming into standard educational practice. Findings showed that children who participated in these programs experienced noteworthy academic achievements. Compared to controls, SEL participants exhibited considerably enhanced social and emotional skills, attitudes, behavior, and academic performance that reflected an 11-percentile-point gain in achievement (Durlak et al., 2011). Staff positivity, the degree to which staff evidenced enjoyment of children in an afterschool program, was positively associated with children's

academic grades, work habits, and social skills with peers; additionally, staff positivity was rated more highly in programs that were more flexible and offered more activities (Pierce et al., 1999). Overall, an effective afterschool program must serve as a supervised environment which allows students to find intrinsic motivation while promoting academics, positive peer and personal skills, and substance abuse prevention.

Conceptual Model

This study follows the theoretical approach of Urie Bronfenbrenner, 1982. Bronfenbrenner suggested that in order to analyze an individual, one must take their entire ecology into consideration. Every individual lives within a macrosystem, with any broad ideologies, laws and customs of one's culture, subculture or social class. Residing within a macrosystem, an exosystem is comprised of local government, unions, and services. Delving deeper, a meso/microsystem will consist of direct relations to the individual such as the systems of family, religious institution, peers, school, and community (Nielsen, 2011). Before we delve into analyzing the efficacy of afterschool programs, we must first identify its location in the Eco-developmental Model and role on youth.

Figure 1. Bronfrenbrenner Eco-developmental Model



All of the systems of this model interact and affect the individual. For instance, educational policy such as NCLB and 21st Century Learning Centers exist within the context of the macrosystem. Community adults, peers, and schools form the micro/mesosystem. An afterschool program falls under the micro/mesosystem which stands as a proximal system to a child within the Eco-developmental Model; moreover, afterschool programs may have sizeable effects on children. The Eco-developmental Model frames a conceptual query regarding the examination of the intricacies of interactions and outcomes between afterschool programs and children.

Afterschool programs, a facet of the micro/mesosystem, connect peers and families which potentially facilitates social bonding. Travis Hirshi, an American criminologist, proposed an influential theory on social control in his 1969 book, *Causes of Delinquency*. He postulated that when an individual has experienced a lack of social connections or a lack of social network that would normally prohibit criminal activity, the likelihood that the individual will participate in criminal activity increases (Ortiz, 2011). According to the Office of Juvenile Justice and Delinquency Prevention, violent crimes by juveniles occur most frequently in the hours immediately following the close of school on school days (OJJDP, 2010). Unstructured socializing with peers in the absence of authority figures presents opportunities for deviance; in the presence of peers, deviant acts will be easier and more rewarding. Furthermore, the absence of authority figures may lead to a lack of structure which generates more time available for deviant behavior (Osgood et al., 1996). If we can find more conclusive evidence in support of engagement in SEL based afterschool programs as a public health tool against problem behaviors, we may be able to pinpoint sensitive precursors in a child's life and handle the specified aspect of a system more consciously in effort to circumvent undesirable outcomes.

Research Review: Attendance, Connectedness, and Reliable Research

With the breadth of findings from past research, one might inquire what other aspects of afterschool programs requires examination. This study holds a different vantage point from previous research. We emphasize the importance of students' attendance *and* connectedness in an afterschool program as major determinants of its efficacy in preventing potential problem behaviors. We operationalize and specify these two factors as attendance at the program and connectedness to the program, staff, and peers.

The most reliable finding amongst these studies is that youth attend infrequently and for a short period of time. No program can make a difference if it does not change the daily experiences of young people, and it cannot do that if attendance is poor; moreover, programs must increase attendance or they will not achieve their goals (Granger & Kane, 2004). On the other hand, researchers have yet to specify relationships between frequency of attendance and the reduction of problem behavior. One naturalistic study found that children who experienced moderate amounts (1–3 hr) of adult-supervised activity-oriented care in the first grade, were rated as significantly more socially competent in the sixth grade when compared to children who received none or high (4 or more hr) amounts of this type of care (Riggs & Greenberg 2004). Is there an attendance threshold for cutoffs to benefits and tradeoffs to time spent?

As opposed to attendance, connectedness embodies a qualitative measure. In fact, a recent study suggests that more connectedness leads to higher attendance (Bulanda & Mccrea, 2013). Intuitively, one would expect to see the workings of group think and peer influence on

individuals connected to a group. Furthermore, a group that is connected and encouraged to positively shape their peers may demonstrate fewer problem behaviors (Smith, Osgood, Caldwell, Hynes, & Perkins, in press). Of the limited research analyzing this subject, researchers conclude that a lack of school engagement negatively affects millions of students, and efforts to connect students to schools should be at the forefront of current initiatives to improve education and substance abuse prevention (Sulkowski et al., 2012). Overall, it appears that after-school programs may have positive impacts on participants, but more rigorous research designs are necessary to provide data that clearly document program effects (Scott-Little et al., 2012).

Some research proposes a need for a balance of afterschool program and parental care during out of school time. A recent study investigated how parents, teachers, and out of school hours care (OSHC) coordinators perceived children's behavior according to three afterschool arrangements: fulltime afterschool care, fulltime parental care, and a combination of both styles of care (Simoncini, Caltabiano, & Lasen, 2012). The Strengths and Difficulties Questionnaire also used our study, rated children's behavior. Simoncini et al.'s study found that teachers and OSHC coordinators reported the most behavior problems in children who were in fulltime afterschool care. Additionally, teachers and coordinators rated boys as having more behavior problems than did girls; however, mothers' reports revealed no differences in children's behavior according to after-school care arrangements or gender. Ideally, childcare during out of school time should not completely rely on afterschool programs for support; supplementary parental care is favored. Unfortunately, many parents do not have that capability due to work. This dynamic prompts research on strengthening afterschool programs given that parents and communities depend on them to care for our children.

Developing and executing reliable research stands as a challenging task. Large variations in samples create complications in comparing research findings. Many research studies focus on large groups of students such as Durlak et al.'s meta-analysis of children K-12 (2011) or very contained groups such as Pierce et al.'s work relating children's experience in after-school programs to first grade performance (1999). This study examines children in 2nd through 5th grades due to their tender age yet ability to comprehend and respond meaningfully to surveys on afterschool programs. Additionally, many research studies target a specific demographic. For instance, Riggs conducted a study of the influence of attendance on the social outcomes of Latino elementary school children who participated in an academically-oriented after school program, based on attendance records and teacher, parent, and child questionnaires (Riggs, 2006) which corresponds with my research question. The current study entails a racially and ethnically diverse sample as opposed to a specific demographic. Within this sample, one may examine and control for racial differences as a supplementary investigation. Nonetheless, Bender et al. (2011) explains how conducting research on afterschool programs creates complex challenges from working with small sample sizes, gauging relevant change in behavior, and threats to internal validity. Their study details a major inherent limitation in the evaluation of afterschool programs: the perplexing problem of assigning youth to receive or not to receive programming. Selection bias and direct sources of efficacy become questionable when utilizing research on voluntary youth enrollment in afterschool programs. Will high levels of motivation among voluntary participants skew results? Moreover, programs vary in purpose, aim, and structure which generate complexity in evaluating program. Despite these challenges, the trajectory of modern society prompts research studies that focus thorough examination on strengthening this growing

sector of child care. This study aims to examine the gaps between previous studies through utilizing a systematic and cluster sample and assessing the two variables of attendance and connectedness to afterschool programs in relationship to reduced potential problem behaviors.

Methodology

Sample

This study involves 2 cohorts of elementary-school-based afterschool programs. During 2009-2010 cohort, one contained 12 southern PA programs; subsequently, in 2010-2011, cohort 2 contained 10 southeastern PA programs. Combined, this sample examines 282 children. Afterschool program providers were contacted and agreed upon participation for a full year. The size of the programs may range from 3 staff and 30 children to as many as 150 children in various grades with 10 staff persons.

Measures

This study examines students' relationships with peers and afterschool staff through two important measures: daily attendance tracking and a detailed survey about their perception and participation in the program.

Attendance

We examine students' attendance through recorded charts with data that spans the entire year. Students' presence was indicated by a check mark on a weekly attendance sheet. In order to depart for the evening, students were signed out by an adult with a time of exit and signature. We obtained the sheets directly from the afterschool program and catalogued each participating child's presence on an excel document that was imported to our SPSS dataset.

Survey

Children in grades two through five received a questionnaire which detailed their participation in the program, behavior, reflections regarding intrapersonal and interpersonal relations, and self-report about problem behaviors. The survey was administered twice, once in the fall and once in the spring to allow students ample time to develop a connection with the program, albeit positive or negative. There were items on the survey that inquired about students' sense of connectedness through posing a statement which required an ordinal response of 1-3 indicating 'not true', 'sometimes true', or 'very true' respectively. The items were coded such that high scores represented a stronger sense of connectedness. Items reflecting less satisfaction with peers and staff were recoded to be consistent with high scores representing more connectedness. Specifically, problem behavior was measured by inquiring about the presence of the several types of undesirable behaviors in the previous 6 months. Concerning the score for the problem behavior and substance use, we used 5 items: (1) "In the past 6 months, have you smoked cigarettes or used other tobacco products"; (2) In the past 6 months, have you on purpose broken, damaged or destroyed something belonging to family, school or neighborhood"; (3) In

the past 6 months, have you drunk any wine, beer or liquor"; (4) In the past 6 months, have you taken something from a store without paying for it"; (5) In the past 6 months, have you smoked marijuana, also called grass, pot, reefer or weed". The response categories for these items are: 1 for Yes, and 0 for No. The scale scores were obtained by computing the average across those 5 items.

Table 1. Afterschool Connectedness

These questions are not about your school day, but just about when you are in the afterschool program.

Statement	Not True	Sometimes True	Very True
I feel close to people at my afterschool program.	1	2	3
I feel like I am a part of my afterschool program.	1	2	3
I am happy to be at my afterschool programs.	1	2	3
The staff in my afterschool program treats children fairly.	1	2	3
I have trouble getting along with the staff at my afterschool program (recoded).	1	2	3
I feel that my afterschool program staff cares about me.	1	2	3
I feel safe in my afterschool program	1	2	3
I like the children in my afterschool program.	1	2	3

Table 2. Problem Behavior and Substance Use

Where would people your age be most likely to get apples or bananas?

a. get them from home
b. buy them from a store
c. get them at school
d. get them from friends

Where would people your age be most likely to get cigarettes?

a. get them from home
b. buy them from a store
c. buy them from a cigarette

In the past 6 months…

have you smoked cigarettes or used other tobacco products?

NO / YES
If yes, how many times?
Once / Twice More / Often

have you, on purpose, broken or damaged or destroyed something that belonged to your parents (person who takes care of you), other people in your family, school, or neighborhood?

NO / YES
If yes, how many times?
Once / Twice More / Often

have you done a chore around the home without being asked in order to help out your family? (Recoded).

NO / YES
If yes, how many times?
Once / Twice More / Often

have you drunk any wine, beer, or liquor?

NO / YES
If yes, how many times?
Once / Twice More / Often

have you taken something from a store without paying for it?

NO / YES
If yes, how many times?
Once / Twice More / Often

have you smoked marijuana, also called grass, pot, reefer or weed?

NO / YES
If yes, how many times?
Once / Twice More / Often

have you given a gift to someone in your family? (Recoded).

NO / YES
If yes, how many times?
Once / Twice More / Often

Consent

Prior to the commencement of this study and collection of data, families were sent two forms of consent which allowed parents to agree or disagree with their child's participation in the study. Both forms were available in Spanish for non-English speaking adults, the children were all found to be able to speak English. If at any point over the course of the study the parents wanted to discontinue their child's participation, their request was honored and data was destroyed. One of the forms, entitled, 'Parental Consent Form for Social Science Research,' regarded the child's participation in the survey and followed an opt-out consent method. Parents were given three to four weeks to return the form, indicating refusal to have their children complete the surveys for the *Strengthening Afterschool Programs* study. If the parent agreed to have their child complete the surveys, no response was needed; however, the parents were asked to keep the form for their records. The other form, entitled 'Parental Informed Consent Form (Active)', involved the child's allowing researchers to collect information about the child's school behavior and achievement as well as permission to videotape and/or photograph the child. Information on school behavior and achievement entailed classroom performance, standardized test scores, attendance, and disciplinary records for the current school year and the following school year. Researchers requested permission for videotaping and/or photography in order to develop training, educational, descriptive, and dissemination of materials. Under FERPA, The Family Educational Rights and Privacy Act of 1974, children could not participate unless parents actively granted consent. Both forms included a purpose for the study, potential risks and benefits, privacy and confidentiality information, and contact information for any questions, comments, or concerns. Parents were also informed that participation in the study was voluntary and would not affect the child's grades; moreover, if the parent and/or child no longer chose to participate, they could indeed drop out at any time without any consequences.

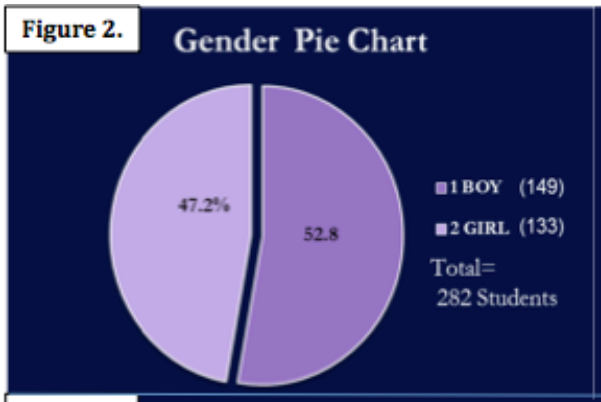
Analysis

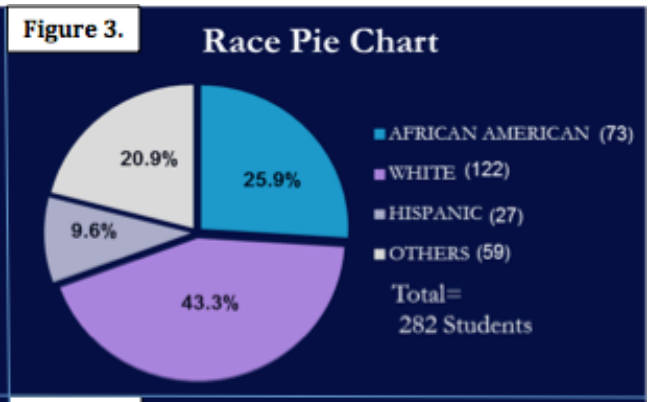
Attendance and responses to the child survey was assessed and examined for relationships with four distinct behaviors: tobacco use, marijuana use, alcohol consumption, and delinquency. Furthermore, multiple regression analyses were utilized on the data to determine if various factors such as race, age, and/or gender affected outcomes. Does attendance and connectedness play a role in reducing potential problem behaviors?

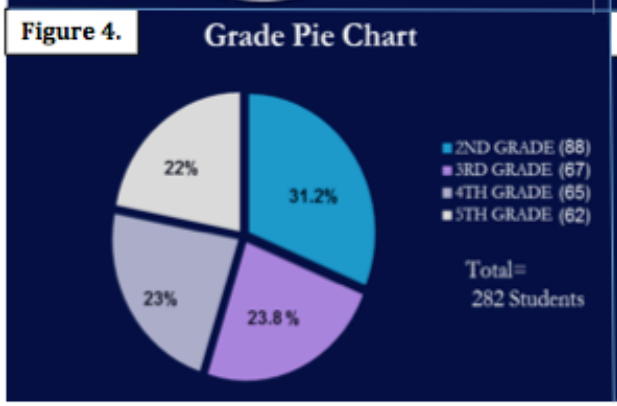
Results

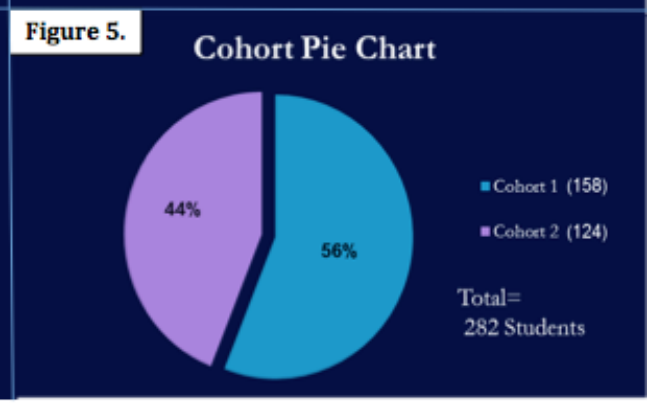
Demographics

Figures 2-5 provide a dissection of the gender, race-ethnicity, grade, and cohorts of the sample respectively. The sample contains 282 students with 52.8% males and 47.2% females. The majority of our population was White (43.3%). Hispanics were the smallest racial-ethnicity subset totaling at 9.6%. African Americans and Others, any race other than White, Hispanic, or Black, were roughly similar at 25.9% and 20.9% respectively. Grades two through are also split similarly with a slightly larger portion of 2nd graders. Cohort 1 accounts for 56% of the sample, leaving the remaining 44% of the population represented through Cohort 2.









Descriptive Statistics on Demographic Characteristics, Connectedness, and Problem Behavior

The descriptive statistics used in this article contained four independent demographic variables: gender, grade, race-ethnicity, and attendance. There were two dependent scales, problem behavior and afterschool connectedness, with a pre and posttest for each scale. The only initial significant finding from our analyses revealed that males experienced more problem behavior and less connectedness; moreover, there were significant differences in attendance regarding race-ethnicity.

Since the original descriptive statistics evidenced significant findings regarding race-ethnicity and attendance, we decided to run a post hoc on each aforementioned variable. The post hoc exposed stark a difference amongst the race-ethnicity variable and attendance.

Table 3. Descriptive Statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
AC Fall	233	1.17	3.00	2.4698	.43881	-.919	.159	.364	.318
AC Spring	194	1.00	3.00	2.4210	.49717	-.939	.175	.223	.347
PB Fall	225	0.00	1.00	.1071	.22704	2.569	.162	6.237	.323
PB Spring	190	0.00	1.00	.1036	.22317	2.644	.176	6.963	.351
Valid N (listwise)	136								

Notes: AC= Afterschool Connectedness; PB= Problem Behavior

Table 4. Race-ethnicity Differences in Afterschool Participation

Multiple Comparisons

Total Days of Afterschool Participation		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1 AFRICAN AMERICAN	2 WHITE	-15.133	6.314	.104	-31.94	1.67
	3 HISPANIC	9.210	9.298	1.000	-15.53	33.95
	4 OTHERS	4.941	7.599	1.000	-15.28	25.16
2 WHITE	1 AFRICAN AMERICAN	15.133	6.314	.104	-1.67	31.94
	3 HISPANIC	24.344*	8.721	.034	1.14	47.55
	4 OTHERS	20.074*	6.882	.023	1.76	38.39
3 HISPANIC	1 AFRICAN AMERICAN	-9.210	9.298	1.000	-33.95	15.53
	2 WHITE	-24.344*	8.721	.034	-47.55	-1.14
	4 OTHERS	-4.270	9.692	1.000	-30.06	21.52
4 OTHERS	1 AFRICAN AMERICAN	-4.941	7.599	1.000	-25.16	15.28
	2 WHITE	-20.074*	6.882	.023	-38.39	-1.76
	3 HISPANIC	4.270	9.692	1.000	-21.52	30.06

*. The mean difference is significant at the 0.05 level.

Table 4 illustrates that Hispanics and Others attend afterschool programs significantly less than Whites.

Internal Consistency

Table 5, a view of the internal consistency of each scale on the survey, supports the validity and reliability of the various items in assessing problem behavior and afterschool connectedness.

Table 5. Internal Consistency

Internal Consistency		
Scale	# Items	Alpha
PB	5	0.77
AC	8	0.84

Correlation Matrix of Problem Behavior, Afterschool Connectedness, and Attendance

Table 6 depicts a correlation matrix giving the correlations between all pairs of data sets. The correlation matrix contains five variables: fall problem behavior, spring problem behavior, fall afterschool connectedness, spring afterschool connectedness, and attendance for an entire school year. Fall problem behavior is positively associated with spring problem behavior, yet inversely associated with fall afterschool connectedness. There is no significant correlation between fall problem behavior and spring afterschool connectedness. Spring problem behavior is inversely correlated with both fall and spring afterschool connectedness. Fall afterschool connectedness was positively associated with spring afterschool connectedness. Our data suggests that connectedness precedes problem behavior outcomes. The fact that fall problem behavior is not related to spring connectedness, but that fall afterschool connectedness has a significant inverse relationship with spring problem behavior is beginning evidence that afterschool connectedness is influencing problem behavior and not vice versa. This temporal precedence is not sufficient enough to declare that afterschool connectedness caused problem behavior. According to the correlation matrix, attendance in afterschool programs has no correlation to any of the aforementioned variables

Table 6. Correlation Matrix

Correlations

		Fall PB	Spring PB	Fall AC	Spring AC	Year Attendance
Fall PB	Pearson Correlation	1				
	N	225				
Spring PB	Pearson Correlation	**.615****	1			
	N	143	190			
Fall AC	Pearson Correlation	**-.285****	**-.352****	1		
	N	223	149	233		
Spring AC	Pearson Correlation	-.152	**-.253****	**.437****	1	
	N	146	183	153	194	
Year Attendance	Pearson Correlation	.060	.049	-.034	-.054	1
	N	195	171	204	175	237

**. Correlation is significant at the 0.01 level (2-tailed).

Notes. PB= Problem Behavior. AC= Afterschool Connectedness

Multiple Regression

Below, Table 7 represents the multiple regression of spring problem behavior. The table serves as a product of a statistical procedure identifying the relationship between two or more independent variables in an effort to identify patterns within the relationship. Each independent variable contains a reference variable. Any variable not listed within a subset of the sample stands as the reference variable. For instance, for race, the reference variable is white. All the variables were entered at once in the regression model. The dependent variable was the "problem behavior and substance use" scale. The independent variable included demographic variables (gender, grade, and race), pre score, attendance, and afterschool connectedness.

Table 7. Multiple Regression of Spring Problem Behavior

Coefficients[a]

Vairable		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
	(Constant)	-.004	.138		.977
	Male	.041	.028	.104	.146
	Black	.045	.038	.092	.242
	Hispanic	.043	.055	.057	.439
	Other	.024	.038	.048	.522
	2nd Grade	.027	.039	.061	.498
	3rd Grade	.011	.042	.023	.790
	4th Grade	.032	.039	.073	.413
	Cohort 1	.001	.030	.003	.969
	Year Attendance	.001	.001	.101	.180
	Fall PB	.549	.070	.573	**.000*** **
	Spring AC	-.055	.032	-.131	**.085***

a. Dependent Variable: Spring PB

*p < .1. ** p < .01. ***p < .05.

Notes. PB= Problem Behavior. AC= Afterschool Connectedness

The data suggests that the quality of participation in afterschool programs has more implications than the quantity of time spent in afterschool programs. Fall problem behavior predicts spring problem behavior while afterschool connectedness affects problem behavior overall. As seen in the Model Summary in Table 8, R-Square is 43%. R-Square is the proportion of variance in the dependent variable spring problem behaviors) which can be explained by the independent variables (gender, race, grade, cohort, attendance, fall problem behavior, and spring afterschool connectedness.

Table 8. Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.655[a]	.429	.377	.15581

a. Predictors: (Constant), Male, Black, Hispanic, Other, 2nd Grade, 3rd Grade, 4th Grade, Cohort 1, Year Attendance, Fall PB, Spring AC

Summary and Discussion

In this article, we explored the relationship of participation and connectedness in afterschool programs to problem behaviors. Revisiting the hypothesis, we can confirm that connectedness is related to problem behaviors; however, we cannot conclude the same for attendance. The sample included a diverse population across gender, grade, race-ethnicity, and cohort. The correlation matrix revealed an inverse relationship between afterschool connectedness and problem behavior. In other words, as afterschool connectedness increased, problem behaviors decreased. Once again, attendance was not significantly correlated to the presence of problem behaviors. The multiple regression table indicated that fall problem behavior stands as the strongest predictor of spring problem behavior. After adjusting the significance cut off, afterschool connectedness became more relevant in predicting spring problem behaviors.

Strengths and Limitations

Our study encompasses several of strengths. The sample included 282 children across 22 programs; however, the predominant population was white, yet we had a sizeable minority population. Undoubtedly, demographics influence results, as previously mentioned. While sizeable, our sample only includes programs in Pennsylvania. Conversely, including both fall and spring measures as a pre and post marks helped establish a baseline for comparison and identify a relative change in our research points. In order to strengthen this study further, one may consider including multiple sources of data. For instance, one could strengthen findings by adding multiple sources of report including teachers and parents. Collecting additional data sources such input from parents or instructors would serve as a validity check for the responses recorded in the child survey.

Future Research

For future research, we would like extend the current literature review on participation and connectedness in afterschool programs to include both school and afterschool. We will likely identify many more articles on connectedness in school and attempt to extend to afterschool. We

would also like to extend the current analyses on Cohort 1 and 2 to also include Cohort 3, data on the greater Philadelphia Area, which is in progress for data entry.

Acknowledgements

The authors would like to acknowledge funding from W.T. Grant Foundation Grant #8529; Wallace Foundation Grant #20080489; and NIH/NIDA Award #R01-DA025187-01A2. We would also like to thank the LEGACY Together Research Team, McNair Scholars Program, and a host of afterschool directors, staff, school personnel, parents, and children for their participation.

References

Afterschool Alliance. (2013). Afterschool Essentials: Research and Polling. Retrieved from http://www.afterschoolalliance.org/Essentials_and_Polling_2013_032713.pdf

Belgrave, F. Z., Chase-Vaughn, G., Gray, F., Addison, J. D., & Cherry, V. R. (2000). The effectiveness of a culture-and gender-specific intervention for increasing resiliency among African American preadolescent females. *Journal of Black Psychology*, 26, 133-147.

Bender, K., Brisson, D., Jenson, J. M., Forrest-Bank, S., Lopez, A., & Yoder, J. (2011). Challenges and strategies for conducting program-based research in after-school settings. *Child and Adolescent Social Work Journal, 28*(4), 319-334. doi:http://dx.doi.org/10.1007/s10560-011-0236-y

Bulanda, J. J., & Mccrea, K. T. (2013). The promise of an accumulation of care: Disadvantaged african-american youths' perspectives about what makes an after school program meaningful. *Child & Adolescent Social Work Journal*, 30(2), 95-118. doi:http://dx.doi.org/10.1007/s10560-012-0281-1

Capaldi, D. M. (2009). Youth after-school programs: Time to involve the parents and community? *Criminology & Public Policy, 8*(2), 413. Retrieved from http://search.proquest.com/docview/200153087?accountid=13158

Conger, R.D., & Elder, G.H. (1994). Families in troubled times: Adapting to change in rural America. Hillsdale, NJ: Aldine.

Dishion, Thomas J., Kenneth Dodge, and Jennifer E. Lansford. 2006. Findings and recommendations: A blueprint to minimize deviant peer influence in youth interventions and programs. In (Kenneth A. Dodge, Thomas J. Dishion, and Jennifer E. Lansford, eds.), Deviant peer influences in programs for youth. New York: Guilford.

Durlak, J. A., & Weissberg, R. P. (2007). The impact of after-school programs that promote personal and social skills. Chicago: The University of Illinois at Chicago.

Durlak, J.A., Weissberg, R.P., Dymnicki, A.B., Taylor, R.D., & Schellinger, K.B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, 82(1), 405-432.

Graczvk, P. A., & Weissberg, R. P. (2003). Implementation, sustainability, and scaling up of social-emotional and academic innovations in public schools. *School Psychology Review*, 32(3), 303-319.

Granger, R. C., & Kane, T. (2004). Improving the quality of after-school programs. *Education Week*, 23(23), 52.

Gottfredson, D. C., Gerstenbirth, S. A., Soule, D. A., Womer, S. C., & Lu, S. (2004). Do after school programs reduce delinquency. *Prevention Science*, 5, 253-266.

Halpern, R. (2002). A different kind of child development institution: The history of after-school programs for low-income children. *The Teachers College Record, 104*(2), 178-211.

Larson, R. W. (2000). Toward a psychology of positive youth development. *American Psycholog*ist, 55, 170-183.

Lerner, R. M. (2005). Liberty: Thriving and civic engagement among america's youth. Thousand Oaks: Sage.

Mahoney, J., & Zigler, E. (2006). Translating science to policy under the No Child Left Behind Act of 2001: Lessons from the national evaluation of the 21st-Century Community Learning Centers. *Journal of Applied Developmental Psychology*, 27, 282-294.

Nielsen, J. N., (2011, November 4). The Second Law of Geopolitical Thought [Web log post]. Retrieved from http://geopolicraticus.wordpress.com/tag/urie-bronfenbrenner/

OJJDP Statistical Briefing Book. Online. Available: http://www.ojjdp.gov/ojstatbb/offenders/qa03301.asp?qaDate=2008. Released on December 21, 2010.

Ortiz, Megan. (2011, October 5). The Social Control Theory [Web blog post]. Retrieved from http://forensicpsychology.umwblogs.org/organized-crime/the-social-control-theory/

Osgood, D. W., Wilson, J. D., Bachman, J. G., O'Malley, P. M., & Johnston, L. D. (1996). Routine activities and individual deviant behavior. *American Sociological Review*, 61, 636-655.

Pierce KM, Hamm JV, Vandell DL. Experiences in after-school programs and children's adjustment in first-grade classrooms. *Child Dev*. 1999 May-Jun;70(3):756-67. PubMed PMID: 10368920.

Riggs NR, Greenberg MT. After-school youth development programs: a developmental-ecological model of current research. *Clin Child Fam Psychol Rev*. 2004 Sep;7(3):177-90. PubMed PMID: 15645707.

Riggs, N. R. (2006). After-school program attendance and the social development of rural latino children of immigrant families. *Journal of Community Psychology*, 34(1), 75-87. Retrieved from http://search.proquest.com/docview/968117485?accountid=13158

Scott-Little, C., Hamann, M., & Jurs, S. G. (2002). Evaluations of after-school programs: A meta-evaluation of methodologies and narrative synthesis of findings. *American Journal of Evaluation*, 23, 387-419.

Simoncini, K., Caltabiano, N., & Lasen, M. (2012). Young school-aged children's behavior and their care arrangements after school. *Australian Journal of Early Childhood, 37*(1) Retrieved from http://search.proquest.com/docview/1282039556?accountid=13158

Smith, E. P., Osgood, D. W., Caldwell, L., Hynes, K., & Perkins, D. F. (in press). Measuring collective efficacy among children in community-based afterschool programs: Exploring pathways toward prevention and positive youth development. *American Journal of Community Psychology*, doi:http://dx.doi.org/10.1007/s10464-013-9574-6

Sulkowski, M. L., Demaray, M. K., & Lazarus, P. J. (2012). Connecting students to schools to support their emotional well-being and academic success. Bethesda: Retrieved from http://search.proquest.com/docview/1018427482?accountid=13158

Tebes, J. K., Feinn, R., Vanderploeg, J. J, Chinman, M. J., Shepard, J., Brabham, T., Genovese, M., Connell, C. (2007). Impact of a Positive Youth Development Program in Urban After-School Settings on the Prevention of Adolescent Substance Use. *Journal of Adolescent Health*, 41(3), 239-247

U.S. Department of Education. (2013). 21st Century Learning Centers: Providing quality afterschool learning opportunities for America's families. Available from http://www.ed.gov/pubs/ Providing Quality Afterschool Learning/report.html

Access to Quality Caregiver Resources: Assessing the Role of Race and Economic Status in the Personal Experiences of Parents Raising Children with Autism Spectrum Disorders

Angelique Murillo, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor
Dr. Erinn Finke, Ph.D
Assistant Professor
Department of Communication Sciences and Disorders
College of Health and Human Development
The Pennsylvania State University

Abstract: Raising a child with Autism Spectrum Disorder (ASD) can be extremely difficult. Recent studies have shown that race, ethnicity, and/or having a low income likely affect parents' experiences raising children with ASD. This research utilizes interviews to obtain direct input from a diverse group of parents for the purpose of contributing to Empowering Communities Against Autism and Pervasive Developmental Disorders (EmCAAP), a program in Harrisburg, Pennsylvania. Through interviews, this project seeks to determine correlations between participant responses and demographics. Based on the patterns we discover, this qualitative approach should be useful to many local initiatives dedicated to improving ASD resources.

Introduction

Children with Autism Spectrum Disorder (ASD) are a rapidly growing population in the United States. In contrast with other developmental disabilities such as ADHD and hearing loss, autism diagnoses grew the most (Boyle, Boulet, Schieve, Cohen et al., 2011). Autism Spectrum Disorder (ASD) consists of five pervasive developmental disorders: Autistic Disorder, Asperger's Syndrome, Rett's Syndrome, Child Disintegrative Disorder and Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS). Disorders on the autism spectrum impair a person's socialization, communication, and language abilities, as well as create behavioral challenges. Medical practitioners and researchers began utilizing the category ASD to acknowledge the various effects of autism. The degree of autism is adapted to the level of a child's functioning. For example, children with Asperger's syndrome may show some behavioral characteristics of autism while also exhibiting higher level functioning.

Many studies examine how raising a child with ASD affects the lives of parents. However, the majority of these studies focus solely on white families. Black and Hispanic families are rarely included and/or solicited in scholarship on this subject. This can lead people to believe that ASD only affects white families and this is not at all the case. The few studies that discuss racial disparities demonstrate that minority and majority families go through different experiences in raising a child with ASD.

Parents of ASD children are strongly influenced by numerous resources they receive after the child's diagnosis. In particular, black families receiving resources about coping with ASD (e.g. brochures, referrals, newsletters/bulletins) may find that race is missing from depictions of ASD. This project will use focus groups with ASD families for the purposes of discovering the needs of black families from the Harrisburg area that have a child with ASD. The study will investigate these needs by examining the process of receiving a diagnosis, coping strategies for parents, and other aspects. The results from this study will be utilized in the creation of a community initiative called Empowering Communities Against Autism and Other Pervasive Developmental Disorders (EmCAAP).

Literature Review

According to the Autism Society of America, autism is a developmental disability that typically appears during the first three years of life and affects a person's ability to communicate and interact with others (2012). Beginning at an early age, the child may face difficulty with joint attention or elicit atypical responses to human faces and voices (Paul, 2007). They also tend to develop speech at a later time and a slower rate. It can often be seen that they have trouble having reciprocal conversations, and some portray echolalia, which is the repetition of others' vocalizations (Paul, 2007). Few studies have examined the relationship between race and ASD, especially in regards to family experiences with the disability.

Prevalence and Diagnosis of ASD

The current prevalence of ASD is most recently reported to be 1 in 50 (Blumberg et al., 2013) which is a significant increase from the 1 in 88 that it was reported to be in 2007. The rising numbers of children with ASD only reinforces the need for an increase in ASD awareness among the general public. Those diagnosed with ASD exhibit symptoms that typically fall into three areas: social impairment, communication difficulties and repetitive & stereotyped behaviors (NIMH, 2011). Despite having these guidelines, diagnosing ASD is a very complex task because no two children with ASD are the same. There are a number of tools that are typically used to diagnose ASD in different settings. The Autism Diagnostic Observation Schedule (ADOS) is often used to provide opportunities for the child to display their level of socialization (Paul, 2007). For parent interviews, two common tools are the Autism Diagnostic Interview (ADI) and the Childhood Autism Rating Scale (CARS). The CARS consists of 15 items in which parents assign a score of 1-4 to specify their child's social progress. Although brief, it has proved to be reliable and valid (Paul, 2007).

Disparities in ASD Diagnosis

Early diagnosis and intervention are extremely important in ensuring the best possible progress in children with ASD (Reichow & Wolery, 2009). However, there are differences that exist in the diagnostic process when comparing African American children to Caucasian children. One of the main disparities is the age of diagnosis. African American children tend to be diagnosed with autism later than their Caucasian counterparts (Mandell, Wiggins et al., 2009) and are more likely to receive an incorrect

diagnosis before reaching their true autism diagnosis (Mandell et al., 2007). Typically, the first diagnosis is a conduct or adjustment disorder. This is critical because a delay in diagnosis leads to a delay in intervention, which lessens the child's potential developmental progress.

ASD has also been described as a non-discriminatory disorder, meaning that is does not affect any race more or less than another. Given this information, it is expected that the numbers of children within the school system that have an autism diagnosis are relatively equal across all races. However, African American, Native American, and Latino children are underrepresented within schools while Caucasians and Asian/Pacific Islanders are overrepresented (Morrier and Hess, 2012). Along the same lines, Mandell et al. (2009) conducted a study to see how many students that fit the criteria actually had a documented diagnosis of autism. By abstracting records from educational and clinical sources, they found that African American children were less likely to have been diagnosed with ASD than Caucasian students.

Another important part of diagnosis is the professional providing the evaluation. Lack of coursework and experience dealing with autism during their careers can leave pediatricians feeling uncomfortable when providing an ASD diagnosis (Finke et al., 2010). Similarly, speech-language pathologists (SLPs) lack education of and exposure to children with ASD. A majority of SLPs have only had a week of training in ASD throughout their undergraduate careers (Schwartz & Drager, 2008). Since a team of professionals can be involved in observing a child to provide an ASD diagnosis, it is important that they have a fluid knowledge of at least the related symptoms. However, it seems that most professionals are lacking in knowledge, and those that do have a basic competency, obtain it through the reading of journals, not from their education (Finke et al., 2010).

Family Experiences with ASD

Raising a child with ASD can cause parents added stress and pressure. Parents need to balance all of their daily demands and continue to be available for all of their child's needs. This requires them to live moment to moment, making it difficult to follow a routine schedule (DeGrace, 2004). Their child's needs tend to take priority over most things, sometimes other family members. If there is another child in the household that is typically developing, they may be slightly neglected because their sibling with ASD requires so much attention (Glazzard & Overall, 2012).

Aside from managing their families internally, parents may also face judgment from strangers. Some children with ASD demonstrate tantrums or other problematic behaviors, and when these occur in public, those that are unaware of the child's diagnosis deem the child disobedient and the parent inadequate (Glazzard & Overall, 2012).

Looking for outside support to care for the child can also prove difficult. Whereas parents of typically developing children can call on a babysitter fairly easily in order to have a night out, most babysitters are not equipped to handle a child with ASD (DeGrace, 2004). And knowing how difficult it can be, parents tend to refrain from calling on extended family members unless it is absolutely necessary (DeGrace, 2004). In regards to resources to help the parents cope, some parents may turn to focus groups to spend time with others who understand what it is like to raise a child with ASD. However, it seems that African American parents are less likely to take part in these

groups (Mandell & Salzer, 2007). This may indicate a lack of available resources or a lack of knowledge of these resources.

Interactions between Parents and Professionals

When looking at the quality of care given to families by their health care professionals, researchers tend to use the measurement of family-centered care. This can be broken down into five categories: spending enough time with the child, listening carefully to the child and family, sensitivity to the family's customs and values, giving the family needed specific information and making the parents feel like partners in the care of the child (Montes & Halterman, 2011). Parents of children with ASD are less likely to report receiving family-centered care when compared to parents of children with other special health care needs. Even further, black parents of children with ASD are less likely to receive enough time with or culturally sensitive care from their health professional. This speaks to both the training of the professionals and the lesser quality of care that black families are receiving.

Costs of Having a Child with ASD

With the number of interventions implemented with a child who has ASD, it is no surprise that having a child with autism is more expensive than having a child who is typically developing. There are numerous services that can be used to help a child with autism, the most popular including a case manager and speech therapy (Kohler, 1999) and unfortunately, not all are covered by insurance, which leaves families to pay out-of-pocket. On average, approximately 14% of a family's income goes toward care for their child with ASD (Montes & Halterman, 2008) and when a family's annual household income was reported to be less than $40,000, they were likely to struggle more (Sharpe & Baker, 2007). It is worthwhile to look into this struggle and address the affect it has on the child's ability to utilize the necessary interventions.

Methodology

Participants

Participants were recruited with the use of flyers posted around popular Harrisburg locations as well as announcements made at local events. A television ad was also created and played on a local Harrisburg network. Participants were both parents/caregivers of children with ASD from the Harrisburg area. One participant was the mother of a 4 year old with autism. The other was a 50 year old woman and the primary caregiver for her 44 year old, nonverbal brother with autism. This allowed us to gather information regarding growing up with a sibling with autism as well as being a primary caregiver. For the purpose of maintaining confidentiality, the mother and 4 year old will be referred to as Allison and Jackson respectively. The woman and her brother that she takes care of will be referred to as Jennifer and Michael respectively.

Procedure

The two interviews were conducted via phone or Skype and recorded. The conversation was led by the researcher with a list of interview questions designed to gather the desired information. Each participant signed an informed consent form and

filled out a demographic questionnaire prior to the interview. For background information, questions included asked about age, location of residency, race, gender, and number of children.

Each interview started with the researcher greeting the participants and thanking them for their participation. The researcher then gave another brief overview of the purpose of the study and got into the main focus group questions that were designed to elicit responses pertaining to their experiences raising a child with ASD and how they were affected by their living situation. We were particularly interested in discovering where they encountered struggles, if and how they overcame them, and what could have helped them in the process. Questions inquired about the process of receiving a diagnosis, services utilized by their child, financing these services and their everyday lives.

Data Analysis

Interviews were recorded and transcribed. The researcher then listened to the interviews multiple times and extracted the main themes and points throughout.

Results

Lots of valuable information was collected from these two interviews. The interview with Jennifer revealed a lot of information pertaining to the adaptation of behaviors done by her and her siblings and how times have changed regarding the attitude toward caring for a child with autism. Jennifer told the researcher that Michael did not receive an official diagnosis until he was a teenager, however they always knew that there was something special about him given his behavior. Two things that he seemed obsessed with were pouring out liquids and floating items in the toilet. Therefore, Jennifer and her other three siblings adjusted by making sure that their doors were locked and their belongings were out of Michael's reach. This prevented anyone from finding a bottle of perfume empty or one of his or her shoes in the toilet. Despite these changes that were made, Jennifer said that none of this really seemed difficult or out of the ordinary. It was all that her family knew; it was their normal.

Although Michael received a diagnosis as a teenager, he was not enrolled in any interventions. He was assigned a case coordinator with his diagnosis but his parents had a different approach to taking care of their son. "They had a 'this is my child and I'll take care of him' mindset (Jennifer). As a result of this, Michael spent all of his time either at school or at home and did not really interact with anyone outside of family. This resulted in the inability for them to have complete family outings. When they would go out to dinner or a movie, someone would have to stay home with Michael.

Four years ago, Jennifer became Michael's primary caregiver. When that transition occurred, Jennifer and Michael's care coordinator got him a behavior support specialist and speech therapist. As a result, Michael has made serious improvements in Michael's communication and behavior. Being nonverbal, he cannot communicate with traditional language, however he is still able to tell people what he wants, needs and how he feels. He is also better being out in public, being patient waiting in line or for food. He is also more involved around the house, doing things such as folding clothes and making snacks for himself. Jennifer says that he has been doing so well that she is going

to transition him into a group home soon, which is something she never would have imagined happening just a few years ago. This will be extremely beneficial because he will be around people who are trained to care for him and can help with the difficulties he still faces with things such as brushing his teeth and maintaining personal cleanliness. He also has health issues caused by him hypersensitivity to stimuli. He cannot get a shot at the doctor or go to the dentist without being sedated. The staff at the group home will be able to maintain his health and further his progress.

Discussion

This interview is a prime example of how times have changed and how critical it is to provide intervention for people with autism. A few decades ago, when the knowledge about autism was limited, parents relied on themselves to care for their children. The thought was not to get their child evaluated or enroll them in programs. The progress that Michael showed within the past four years is a prime example of the efficacy and importance of interventions for people with autism. Jennifer believes that his improvements would be even greater had he started earlier.

But these resources are not always available which leaves a lot of children undiagnosed with no interventions. When asked what she wanted for her brother, Jennifer said that she wanted Michael to have a good quality of life however he would define it. That is exactly the purpose of interventions, to allow the individual to communicate effectively which can increase happiness.

Limitations and Future Plans

The two main limitations for this study were time and recruitment. Given that the researcher only had 9 weeks to complete the project, she was not able to go as in-depth and she would have liked. Along the way, it was also realized how difficult it is make connections with people from the targeted population. It remains even more difficult to find a time where the caregiver is completely free to engage in an interview given the hectic schedule associated with raising a child with ASD.

In the future, we plan to put in more time in order to conduct the focus groups we originally desired. After gaining information about what resources are lacking, we will work with Empowering Communities Against Autism and Pervasive Developmental Disorders (EmCAAP) to provide the necessary resources and raise awareness about autism altogether.

References

Blumberg, S. J., Bramlett, M. D., Kogan, M. D., Schieve, L. A., Jones, J. R. & Lu, M. C. (2013). Changes in prevalence of parent-reported Autism Spectrum Disorder in school-aged U.S. children: 2007 to 2011-2012. *National Health Statistics Report, 65*

Boyle, S. B., et al. (2011). Trends in the prevalence of developmental disabilities in US children, 1997-2008. *Pediatric, 127, 6*, 1034-1042. doi: 10.1542/peds.2010-2989

DeGrace, B. W., (2004). The everyday occupation of families with children with autism. *The American Journal of Occupational Therapy. 58(5)*, 543-550.

Diagnostic and statistical manual of mental disorders: Dsm iv. (2002, June 26). Retrieved fromhttp://www.autreat.com/dsm4-autism.html

Finke, E.H., Drager, K. D. R., & Ash, S. (2010). Pediatricians' perspectives on identification and diagnosis of autism spectrum disorders. *Journal of Early Childhood Research, 8*, 254- 268.

Glazzard, J. & Overall, K. (2012). Living with autistic spectrum disorder: Parental experiences of raising a child with autistic spectrum disorder (ASD). *Support for Learning. 27(1)*, 37-45.

Ludlow, A., Skelly, C., & Rohleder, P. (2011). Challenges faced by parents of children diagnosed with autism spectrum disorder. *Journal of Health Psychology.* 1-10.

Mandell, D. S. & Salzer, M. S. (2007). Who joins support groups among parents of children with autism? *Autism, 11*, 111-122.

Mandell, D. S. et al. (2009). Racial/Ethnic disparities in the identification of children with autism spectrum disorders. *American Journal of Public Health. 99(3).* 493-498.

Montes, G. & Halterman, J. S. (2008). Association of Childhood Autism Spectrum Disorders and Loss of Family Income. *Pediatrics.* doi: 10.1542/peds.2007-1594

Montes, G. & Halterman, J. S. (2011). White-Black Disparities in Family-Centered Care Among Child with Autism in the United States: Evidence From the NS-CSHCN 2005-2006. *Academic Pediatrics, 11.* 297-304

Paul, R. (2007). Special considerations for special populations. In K. Falk(Ed.), *Language disorders from infancy through adolescence* (3rd ed. pp. 137-138). St. Louis, MO: Mosby Elsevier

Reichow, B. & Wolery, M. (2009). Comprehensive Synthesis of Early Intensive Behavioral Interventions for Young Children with Autism Based on the UCLA Young Autism Project Model. *Journal of Autism and Developmental Disorders, 39.* 23-41

Schwartz, H. & Drager, K. D. R. (2008). Training and Knowledge in Autism Among Speech-Language Pathologists: A Survey. *Language, Speech, and Hearing Services in Schools. 39.* 66-77

Tek, S. & Landa, R. L. (2012). Difference in autism symptoms between minority and non-minority toddlers. *Journal of Autism and Developmental Disorder.* Advance online publication. doi: 10.1007/s10803-012-1445-8

Performance Evaluation of the Radon Transformation in Limited Angle Radar Tomography

Joshua Alton Noble
Pennsylvania State University

Faculty Research Advisor:
Ram Narayanan, Ph.D.
Professor of Electrical Engineering
Department of Electrical Engineering
College of Engineering
Pennsylvania State University

Abstract

The Radon Transformation is an image processing algorithm widely used in the field of tomography. Limited angle tomography takes only a partial view of an object while conventional tomography images the target from all angles. This paper examines how effective the Radon Transformation is at reassembling images when presented with less than ideal limited angle tomographic data. In the first part of this experiment, a simulation is conducted in MATLAB where a pre-established image (Logan-Shepp phantom) is broken down and reassembled using this algorithm. In the second part, and experimental radar tomography station is built to collect real time tomographic data. The Radon Transformation is then used in an attempt to reassemble this back projection data into a cross sectional image. The effectiveness of this algorithm in these situations will be determined by the quality of the final images.

1 – Introduction

Radar imaging systems are widely studied by both engineers and scientists due to their ability to accurately reproduce images. In particular, the field of radar tomography is of great interest because these systems are capable of reproducing two, or even three-dimensional images of objects. Radar tomography's benefits have led to its adoption in several scientific fields. For instance, medical practitioners could use it for imaging the body without the use of ionizing radiation, whereas geoscientists map the subterranean world with ground penetrating radar.

The field of radar imaging has been around for at least half a century. Early radar systems were used to detect large ships on the ocean or cloud density for meteorological data. These early systems were able to detect the distance and relative size of an object, but lacked detail. Radar tomography expands on early radar detection by integrating its basic methods with computational software such as MATLAB or Mathematica. With today's computing power, which continues to become more accessible, researchers are able to add much more detail into images.

2.1 - Basic Radar Systems

Before examining how three dimensional radar tomography is implemented, it is necessary to first understand how one and two-dimensional imaging works. An electromagnetic wave (typically 100MHZ-100GHZ) is sent out from a transmitter (TX) while a receiver (RX) listens for a reflected wave. The distance of the target is computed with a basic calculation that compares the time it takes the wave to reflect back off the target to the receiver. A radar echo resembles an echo heard by the human ear. Its functions are limited to determining the relative size, distance, and location of an object. More complex imaging systems such as synthetic aperture radar (SAR) and radar tomography differ from a radar echo because they send out a series of waves that impact the target. When these systems are combined with computational software, they are able to not only look for shifts in time, but also in frequency, polarization, cohesion, and phase.

2.2 – Tomography

The field of tomography is concerned with reconstructing images of objects. This can be done with several types of electromagnetic radiation including, though not limited to radar, visible, and x-ray. A conventional tomographic station has a transmitter and receiver placed opposite of one another along a radial axis. A network analyzer sends out an incident waveform and listens for the received waveform. The received waveform will be distorted by its interaction with the object. This is observed as changes in frequency and phase. The TX/RX pair is moved by a small increment and another waveform is sent out. This process is repeated several times to produce a collection of one-dimensional echoes (Tseng and Chu). The mathematical result of this process is a $[1 \times n]$ matrix where n represents the number of one-dimensional echoes. Sweeping θ for 180 degrees will result in a complete set of back projection data for the object. Integrating this collection of echoes and performing an image reconstruction algorithm results in the reconstruction of an object in the form of a two-dimensional cross section (Knaell).

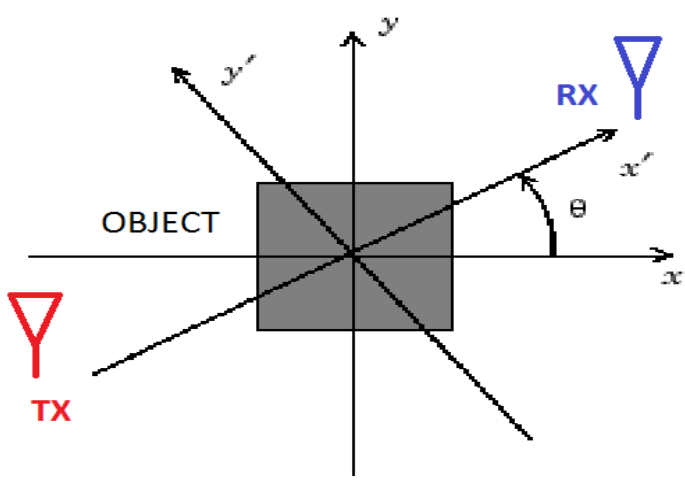


Figure 1: Depiction of a conventional tomographic approach

2.3 – Limited Angle Tomography

This paper examines limited angle tomography in particular. In a conventional tomography station, the TX/RX pair is rotated around 180 degrees around an object. This method illuminates the entire object and provides a very accurate reconstruction. However, this approach also severely limits the capabilities of such systems by requiring large, rotating gantries for imaging larger objects. Limited angle tomography differs from conventional tomography because the TX/RX pair is not rotated a full 180 degrees around a target. Such a system is capable of imaging large objects or even taking partial images that would otherwise be impossible. One drawback of limited angle tomography is that it obviously does not illuminate the entire target. This may yield less than ideal images when compared to a conventional approach.

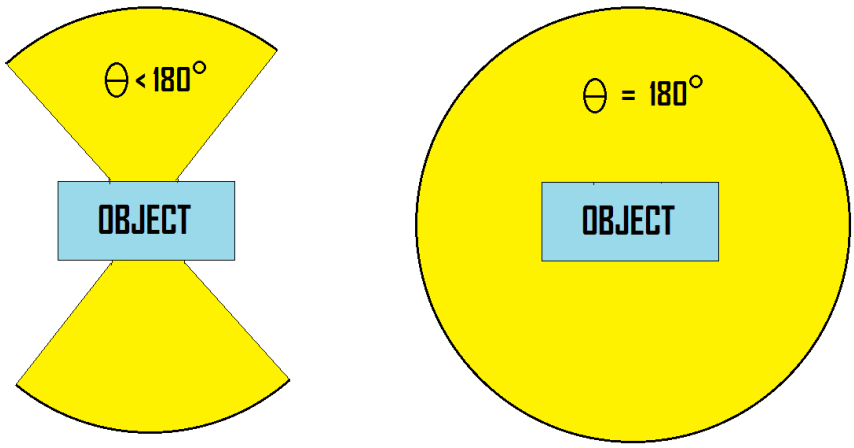


Figure 2: Range of illumination (θ) for limited angle vs. conventional tomography

2.4 –Radon Transformation

The Radon transformation is used in image processing for reconstructing images. While the mathematics of the Radon transformation are beyond the scope of this article, it is similar to the Fourier transform. When a tomography station takes an image, it stores the data as a back projection sinogram. The Fourier slice theorem states that if a sufficient number of these back projections are taken along a full 180 degrees, the object can be reconstructed perfectly (Knaell). At less than 180 degrees, however, the image clarity begins to degrade. This is due to a growing null space in the back projection data. When the null space reaches a critical size, the Radon transformation will be ineffectual at reassembling the image. Recent research has shown that it may be possible to reconstruct image with a very high degree of clarity using the Radon transformation in conjunction with interpolation and filtering algorithms (Xue, et. al.). This paper investigates the effectiveness of the Radon transformation in reproducing images without the addition of interpolation or filtering algorithms.

2.5 – Logan-Shepp Phantom

The Logan-Shepp head phantom is widely used in the field of tomography and image processing. The phantom contains several contrasted regions that replicate conditions encountered in experimental imaging. Specifically, it was developed to test image reconstructions algorithms for use in the field of medical tomography.

Figure 3: The Logan-Shepp phantom reconstructed perfectly

2.5 – Higher Order Tomography

The prime result of a two-dimensional tomographic reconstruction is a detailed cross section of an object. Furthermore, a three-dimensional image can be produced by integrating several cross sections together. Current three-dimensional imaging techniques require the transmitter or receiver be moved in two dimensions. As explained previously, the transmitter is moved along the *x*-axis to create a single two-dimensional cross section. The transmitter is then moved along the *y*-axis and the process is repeated (Knaell). This approach creates a [$m \times n$] matrix where m and n represent the number of one-dimensional echoes in the x and y directions, respectively. Given that creating a two-dimensional cross section requires much more computing power than a one-dimensional image, developing three-dimensional images demands an extraordinary amount of computing resources.

2.6 – Frequency Considerations

When examining various objects, it is also necessary to pre-determine the relative size (mountain, warehouse, car, suitcase, etc.) The resolution of a radar system is proportional the frequency used. This can range anywhere from around 100MHz to upwards of 100GHz. The advantage of using higher frequencies is that higher resolutions can be obtained (Gilmore, et. al). On the other hand, lower frequency bands can be used to peer through foliage and walls, but lack the resolution and range of high frequency transmissions. It is also important to note that objects have different permittivity constants depending on the frequency of incident wave (Zanoon et. al.). This explains why a brick wall is opaque to the human eye at 500THz, but nearly transparent at 500MHz (Verity and Gavrilav). The same principle applies to radar imaging. For three-dimensional tomography, a band of frequencies in the range of 2GHz-10GHz have been shown to be effective at imaging objects on the scale of a few meters (Gilmore et. al). This could also be accomplished using an ultra-wideband approach.

3.1 – Experimental Station

Tomography requires that either the object or antenna must be moved to generate valid data. Conventional tomography stations involve rotating either the object or the TX/RX pair a full 180 degrees. This experiment employs limited angle tomography which allows for imaging of larger

objects. In this design, the transmitter is moved along the horizontal axis for a distance of 1 meter. The object to be imaged is placed in front of the antenna pair at a specified distance. When an object is present, the incident wave is reflected by the target and picked up by the receiver. The advantage of this design is its flexibility and ease of use.

To reliably move the transmitter, it is attached to a linear actuator. This linear actuator is controlled by software, allowing it to be moved in precise increments. To move the transmitter, a script in MATLAB communicates with a National Instruments data acquisition box (DAQ). The DAQ then outputs a high signal on one of two lines to signal the linear actuator to move left or right. The DAQ alone does not enough current to drive the linear actuator, so a simple relay circuit is used between the DAQ and the linear actuator. This design can be easily expanded to three-dimensional tomography by adding another linear actuator along the vertical axis.

An Agilent network analyzer (NA) is used to send out radar waves, measure the S-parameters of the network, and port the data out for processing. The S-parameters include complex values that represent the amplitude and phase components of the reflected wave. The bandwidth of the network analyzer is set to collect data over a range of frequencies between 8GHZ and 12GHz. This produces resolutions on the order of centimeters. Ideally, a higher frequency would result in a higher resolution, but equipment capable of operating at these speeds is rare and expensive. Additionally, low noise amplifiers are attached to both the transmitter and receiver to boost the received signal strength to nearly -10dBm.

The data is collect as a $[m \times n]$ matrix where m represents the number of increments that the transmitter is moved and n represents the number of discrete frequencies. Increasing these numbers yields a higher quality image, but requires more time. A separate MATLAB script processes this data into an image by utilizing the Radon transformation.

3.2 – Image Processing Script

The image processing script is responsible for both processing the raw experimental data into an image and for the simulations. In the simulations, the phantom is first broken down into its constituent data which replicates the matrix of reflection or transmission coefficients gathered by a network analyzer. The inverse Radon transformation then reassembles the data into a final image. The quality of this image depends on both the range of illumination (θ) and the number of radial projections taken. The images were reconstructed with views ranging from 30 degrees to a full 180 degrees.

4.1 – Simulation Results

As explained previously, the image processing script was first tested with a pre-established image in the form of the Logan-Shepp head phantom. The figure below shows the results of reconstruction by varying the range of illumination.

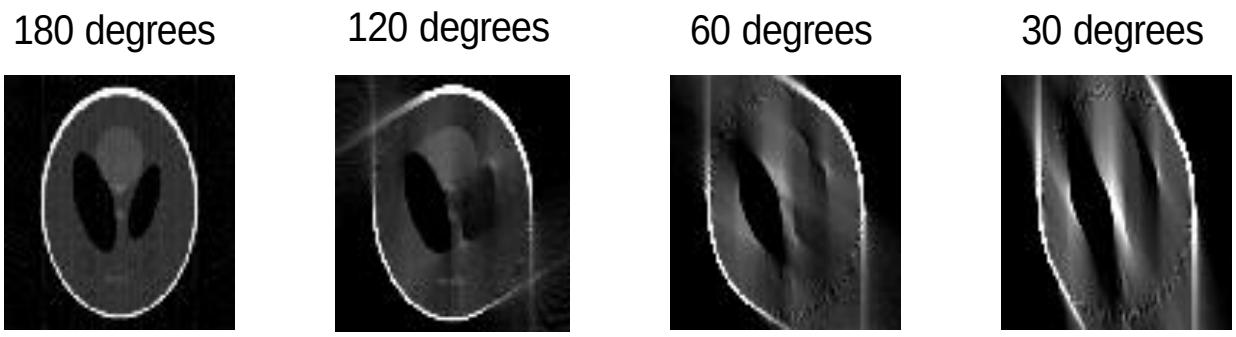


Figure 4: Results of image reconstruction based on varying ranges for θ

At a full 180 degrees, the image is reconstructed almost perfectly. The dark and light ellipses inside are easily seen and discerned. The only difference from the original image is observed in the outer white ellipse. This structure is slightly pixilated from the reconstruction process. The lack of artifacts also shows the number of projections is set sufficiently high.

At 120 degrees of illumination, the image is somewhat distorted along the corners. This is still a wide enough angle that the internal features can be observed, if not as clearly. With the addition of interpolation algorithms that are beyond the scope of this paper, it may be possible to reconstruct the image.

At 60 degrees of illumination, the outer distortions in the image are very evident. This is caused by the growing null space in the matrix where the target is not illuminated. The internal features are also skewed and blurred. The two dark ellipses in the center are still visible and retain most of their shape. The grey circles on the top and bottom, however, are beyond recognition.

At 30 degrees of illumination, the object is heavily distorted and bears little similarity to the original image. The two dark ellipses are distorted and the other grey ellipses have vanished completely.

In the experimental tomography station, the object is placed at distances of 1, 3, and 6 meters from the target while the transmitter is swept for a distance of 1 meter. Again, this was simulated through MATLAB using the Shepp-Logan phantom. The figure below shows the results of this.

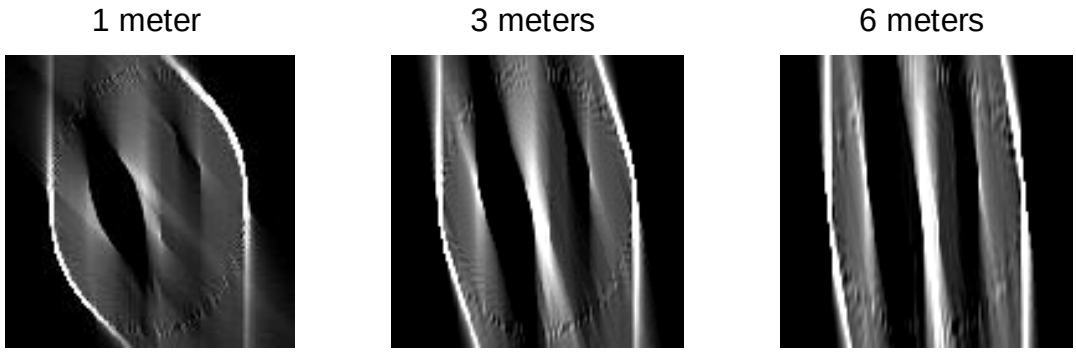


Figure 3: Results of image reconstruction at simulated distances

At a simulated distance of 1 meter, the object is heavily distorted, but some basic structures are still visible, most notably the two dark ellipses in the center. At distances of 3 meters and beyond, the object is very heavily distorted and does not display much resemblance to the original image. Based on these results, the Radon transformation alone is not effective at reproducing images at very limited ranges of illumination.

4.2 – Experimental Results

The experimental tomography station was built to collect data for later processing. The plots below show the raw range data of a human target at a distance of 1 and 3 meters, respectively.

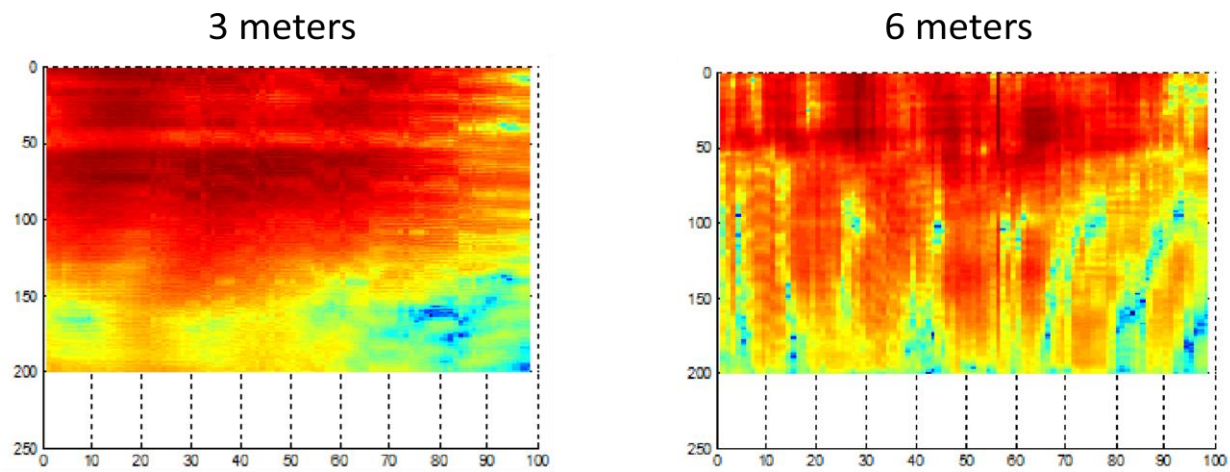


Figure 6: Range data collected by the experimental station

At a distance of 3 meters, the dark red image confirms that the station works as intended. At this close range, individual features blur together. This could also be due to unwanted antenna coupling between the transmitter and receiver. At a distance of 6 meters, we begin to see some detail and separation of features. At a distance farther than this, the features would begin to blur together again. While these images confirm the tomographic station can collect range data, it is not detailed enough to use for an accurate reconstruction.

5 – Discussion of Results

It has been shown that as the range of illumination decreases, the null space of the matrix increases. This leaves large areas of the back projection sinogram blank, and results in decreased image quality. Based on the simulation results, the Radon transformation alone is not adequate for processing limited angle tomographic data. Given sufficiently large angles though, ($\theta > 120$ degrees) the Radon transformation produces relatively accurate reconstructions. The edges of the target blur around the corners, but the interior features are still easily seen and contrasted. At smaller angles, the image distorts heavily and the internal features become nearly indistinguishable. These limited angle images may provide clues to the internal structure of a target, but cannot be relied on for high resolution images. Using the Radon transformation in

conjunction with filtering and interpolation algorithms may increase the image clarity at these very limited angles.

The experimental station functions as it was intended. The range plots provide evidence that this type of station can be used for imaging. Unfortunately, this data is not clean enough to use for tomographic reconstruction. Modifying this station by placing the receiver across from the transmitter or using a larger bandwidth may or may not provide cleaner data to use for reconstruction.

6 – References

Gilmore, Colin, Stephen Pistorious, and Cam Kaye. "An Ultra-wideband Microwave Tomography System: Preliminary Results." *ENBC* (2009): 2288-293. Print.

Knaell, K.K. "Radar Tomography for the Generation of Three-dimensional Images." *IEE Proceedings - Radar, Sonar and Navigation* 142.2 (1995): 54. Print.

Tseng, Chao-Hsiung, and Tah-Hsiung Chu. "An Effective Usage of Vector Network Analyzer for Microwave Imaging." *IEEE Transactions on Microwave Theory and Techniques* 53.9 (2005): 2884-891. Print.

Verity, A. A., and S. P. Gavrilov. "Subsurface Tomography Application for Through-Wall Imaging." *Subsurface Sensing* 10.2 (2011): 702-06. Print.

Xue, Rui-Fai, Bin Yuan, and Ye Liu. "Tomographic Inverse Scattering Approach for Radar Imaging with Multistatic Acquisition." *IEEE International* 7 (2005): 4620-626. Print.

Zanoon, Tareq F., SaeedBinajjaj, and Moid Z. Abdullah. "Electromagnetic Tomography Featuring Ultra Wide Band Sensor with Conformal Finite Difference (CFDTD) Modeling of Dispersive Media." *ISIEA 2009* 6th ser. 15.10 (2009): n. pag. Print.

The Role of Peroxisome Proliferator-Activated Receptor-β/δ (PPARβ/δ) in the Human MCF7 Breast Cancer Cell Line

Dylan A. Phillips, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisors:
Dr. Jeffrey M. Peters, Ph. D
Distinguished Professor of Molecular Toxicology & Carcinogenesis
Department of Veterinary and Biomedical Sciences
and The Center of Molecular Toxicology and Carcinogenesis,
The Pennsylvania State University

Dr. Pei-Li Yao, Ph. D
Postdoctoral Researcher:
Department of Veterinary and Biomedical Sciences
and The Center of Molecular Toxicology and Carcinogenesis,
The Pennsylvania State University

Abstract

The role of PPARβ/δ in breast carcinogenesis remains unclear because some studies show that activating this receptor promotes breast cancer cell growth, while other studies show that activating this receptor inhibits breast cancer cell growth. Further, some studies suggest that the function of PPARβ/δ can be altered by the presence of fatty acid binding protein 5 (FABP5) and cell retinoic acid binding protein-II (CRABP-II) by diverting atRA or PPARβ/δ agonists to PPARβ/δ and promote cell proliferation by preventing activation of retinoic acid receptors (RARs). This study examined the effects of PPARβ/δ on cell proliferation in the presence of GW0742 (a PPARβ/δ agonist), GSK0660 (a PPARβ/δ antagonist) and all-trans retinoic acid (atRA a putative PPARβ/δ agonist) in a genetically engineered human MCF7 breast cancer cell line. Control cells (MCF7), cells infected with a control retrovirus (MCF7-MigR1), or cells infected with a retrovirus expressing PPARβ/δ (MCF7-MigR1 hPPAR) were treated with either atRA, GSK0660 and/or GW0742 and gene expression and cell proliferation were examined. This allowed for examining the hypothesis that the activity of PPARβ/δ can be altered by FABP5/CRABP-II ratio in a human breast cancer cell line. The mRNA levels of the PPARβ/δ target gene, adipose differentiation-related protein (*ADRP*) were increased by treatment with GW0742 but not by atRA. In contrast, atRA increased expression of the RAR target gene *CYP26A* but GW0742 had no effect on expression. While GSK0660 inhibited GW0742-induced *ADRP* mRNA, it had no effect on *ADRP* or *CYP26A* mRNA expression. The FABP5/CRABP-II ratio was measured by western blot analysis and relatively high. However, over-expression of PPARβ/δ did not influence the effect or lack of effect of GW0742 or atRA. Cell proliferation in response to GW0742, GSK0660 and atRA in MCF7 cells was not different between treatment

groups. Results from these preliminary studies show argue against a role of FABP5 delivering ligands to PPARβ/δ in human breast cancer cells and altering gene expression by activating this receptor. Whether PPARβ/δ affects cell proliferation in these models must be further examined because of high variability.

Introduction

Peroxisome proliferator-activated receptor (PPAR) is a member of the nuclear hormone receptor superfamily. These receptors function as transcription factors to regulate gene expression and are activated by endogenous ligands or synthetic compounds which have been thought to behave similar to natural ligands. Discovered back in the early 1980's, PPAR has been divided into three separate isoforms including PPARα, PPARβ/δ and PPARγ. Each isoform may vary with its effects on the growth of different types of cells. With PPARγ the most known because it has been used for cancer treatment today (1). The least known PPAR is PPARβ/δ. Since its original discovery by Krey et. al. in 1993 (2), there has been no clear determination of the characteristics and effects PPARβ/δ has on the human body. Unclear determination is mostly due to opposite conclusions drawn on proliferation properties of PPARβ/δ (3, 4).

On the other hand, the role of retinoic acid and its receptor, retinoic acid receptor (RAR), in cancers has been the subject of many reports. Retinoic acid's inhibitory effect on cell proliferation has been mostly agreed upon (3, 5, 6). According to their similar binding pockets for the receptors, there may be a competitive interaction between the RAR and PPARβ/δ (7). This relation has been in major discrepancy lately involved two retinoic acid transports, fatty acid binding protein 5 (FABP5) and cellular retinoic acid binding protein-II (CRABP-II). One theory is: retinoic acid predominately operates through RAR inhibiting cell growth, but when a high FABP5/ CRABP-II ratio is present, retinoic acid binds with PPARβ/δ and activates cell proliferation (7, 8, 9). Another theory is: There is no interaction between retinoic acid and PPARβ/δ, even in high FABP/CRABP-II ratios (3, 6, 10, 11).

The first theory is assuming PPARβ/δ is a cell proliferator which has not been clearly determined. Also, human breast cancer cell line MCF7 has been shown to express a low FABP5/CRABP-II ratio (8), which will be useful in determining the effect PPARβ/δ has on the cell line alone. Therefore, in the present study, I will examine the effects of the PPARβ/δ agonist (GW0742) and the PPARβ/δ antagonist (GSK0660) on cell proliferation. I will also look at the effect the RAR agonist all-trans retinoic acid (atRA) has on MCF7 cells. I will be measuring the mRNA levels of known PPARβ/δ target genes adipose differentiation-related protein (*ADRP*) along with RAR target gene cytochrome P450-26A (*CYP26A*) using qPCR. I will also examine the protein levels of FABP5 and CRABP-II which have been mentioned before. Cell proliferation will be detected in real-time after activating or inhibiting PPARβ/δ in MCF7 cells. Dr. Peters' laboratory previously generated MCF7 hPPARβ/δ cells which are stably over-expressing human PPARβ/δ. This cell line allows me to estimate the effect high expression of PPARβ/δ has on cell proliferation compared to control MCF7 cell line. Therefore, GW0742, GSK0660 and atRA will also be used in MCF7 hPPARβ/δ cells.

Materials and Methods

Cell culture

Human breast cancer cell line MCF7 was purchased from American Type Culture Collection (ATCC, Manassas, VA). Cells were maintained in Dulbecco's minimal essential medium (DMEM) with 10% non-essential amino-acids, 10% fetal bovine serum and 1% penicillin/streptomycin at 37°C and 5% CO_2. The parent MCF7 cells, MCF7 cells with the retroviral empty vector (MCF7 MigR1), or MCF7 cells over-expressing PPARβ/δ (MCF7 hPPARβ/δ) were used.

Treatment

PPARβ/δ antagonist GSK0660 and agonist GW0742 were synthesized by GlaxoSmithKline (Research Triangle Park, NC) (Sznaidman et al., 2003). MCF7 cells were treated with 0, 0.1 and 1 μM of GSK0660 or GW0742 for 24 h, or co-treated with GSK0660 and GW0742. All-trans retinoic acid (atRA) was purchased from Sigma-Aldrich (St. Louis, MO). Cells were treated with atRA for 8 and 72 h.

Western blot analysis

Protein was isolated using radioimmunoprecipitation assay buffer (5% Tris-HCl pH7.5, 3% NaCl, 1% NP-40 and 0.5% Sodium deoxycholate) and protease inhibitors. Ten μg of protein per sample was resolved in 12% SDS-polyacrylamide gels. Proteins were transferred onto polyvinylidene fluoride membrane using an electroblotting method. The membranes were blocked with 5% dried milk in Tris-buffered saline/Tween 20 (TBST) and incubated at 4°C overnight with primary antibodies against CRABP-II (1:1000, Abcam, Cambridge, MA), FABP5 (1:1000, BioVision, Milpitas, CA) and ACTIN (1:500, Santa Cruz Biotechnology Inc., Santa Cruz, CA). After incubation with biotinylated secondary antibody (1:2000, Jackson ImmunoResearch Laboratories, West Grove, PA), immunoreactive proteins on the membrane were detected by ^{125}I-labeled streptavidin (GE Healthcare, Chalfont St. Giles, Buckinghamshire, UK). ACTIN was used as the loading control.

Quantitative polymerase chain reaction (qPCR)

Total RNA was extracted using RiboZol RNA Extraction Reagent (AMRESCO, Solon, OH) and the manufacturer's recommended protocol. The expression levels of glyceraldehyde 3-phosphate dehydrogenase (*GAPDH*), adipose differentiation-related protein (*ADRP*), and cytochrome P450-26A (*CYP26A*) were measured using qPCR. cDNA was generated using MultiScribe Reverse Transcriptase (Applied Biosystems, Foster City, CA).The MyiQ Real-time PCR Detection System (Bio-Rad Laboratories, Hercules, CA) was used to detect the quantitative signals from SYRB© Green PCR Supermix (Quanta Biosciences, Gaithersburg, MD) in the iCycler. The following cycle was used for all PCR run: 95 ºC for 10s, 60 ºC for 30s, and 72 ºC for 30s, repeated 45 times. The relative mRNA was normalized according to the *GAPDH* gene.

Cell proliferation

MCF7 parent cells, MCF7 MigR1 cells and MCF7 hPPARβ/δ cells (1,200 cells) were plated onto 16-well Eplate. Changes in cell index were measured using an xCELLigence RTCA DP (ACEA

Biosciences, Inc., San Diego, CA), real-time cell monitoring instrument. During the first 24 hours, cell index was counted once every 15 minutes. After 24 hours, the PPARβ/δ agonist GW0742 and/or the PPARβ/δ antagonist GSK0660 was added into cells. Cell index was then counted once every hour for an additional 48 hours. Triplicate samples for each treatment were used for each time point, and each replicate was counted three times.

Statistical analysis

All experimental groups were performed in triplicate and repeated using three sets of cells. The data were subjected to a parametric one-way analysis of variance (ANOVA) followed by Tukey test for post hoc comparisons. Statistical significance was considered to be achieved when $p<0.05$.

Results

PPARβ/δ antagonist GSK0660 suppressed GW0742-induced *ADRP* expression in MCF7 cells

Over-expression of PPARβ/δ induced ~2-fold expression of *ADRP* in MCF7 cells (Fig. 1). The activation of PPARβ/δ by GW0742 further induced *ADRP* mRNA level in MCF7 hPPARβ/δ cells (Fig. 1). PPARβ/δ antagonist GSK0660 treatment suppressed GW0742-induced *ADRP* expression in MCF7 hPPARβ/δ cells (Fig. 1); however, GSK0660 alone did not affect *ADRP* mRNA level (Fig. 2).

PPARβ/δ agonist GW0742 decreases GSK0660-induced *CYP26A* expression in MCF7 cells

Over-expression of PPARβ/δ decreased *CYP26A* expression in MCF7 cells (Fig. 3). Interestingly, the high dose of GSK0660 treatment induced *CYP26A* expression in MCF7 MigR1 and MCF7 hPPARβ/δ cells, while the low dose of GSK0660 induced *CYP26A* in MCF7 parent cells (Fig. 3). This suggests that the inhibition of PPARβ/δ activity may increase the RAR signaling. *CYP26A* expression was decreased in MCF7-MigR1 cells after GW0742 treatment while increased in MCF7 hPPARβ/δ cells (Fig. 4). Additionally, in MCF7 MigR1 cells, GSK0660-induced *CYP26A* expression was inhibited by GW0742 treatment (Fig. 4).

The effect of atRA on *CYP26A* and *ADRP* expression remains unclear

After treatment with the MigR1 vector, there was a decrease in the *CYP26A* expression after treatment with atRA. Without the vector, 1μM atRA treatment greatly increased the *CYP26A* expression; however, 10 μM atRA treatment greatly decreased *CYP26A*. The decrease in *CYP26A* after 10 μM treatment went down in all cell types. No significant change occurred in the *ADRP* expression no matter the atRA treatment.

Activation or inhibition of PPARβ/δ has no participation in cell proliferation in MCF7 cells

By using xCELLigence system, we were able to monitor cell growth in real-time. No significant difference in cell proliferation had been observed among MCF7, MCF7 MigR1, and MCF7 hPPARβ/δ cells. The PPARβ/δ agonist GW0742 and/or the PPARβ/δ antagonist GSK0660 were also applied to cells; however, there is no significant change in any cell treatments (Fig. 7).

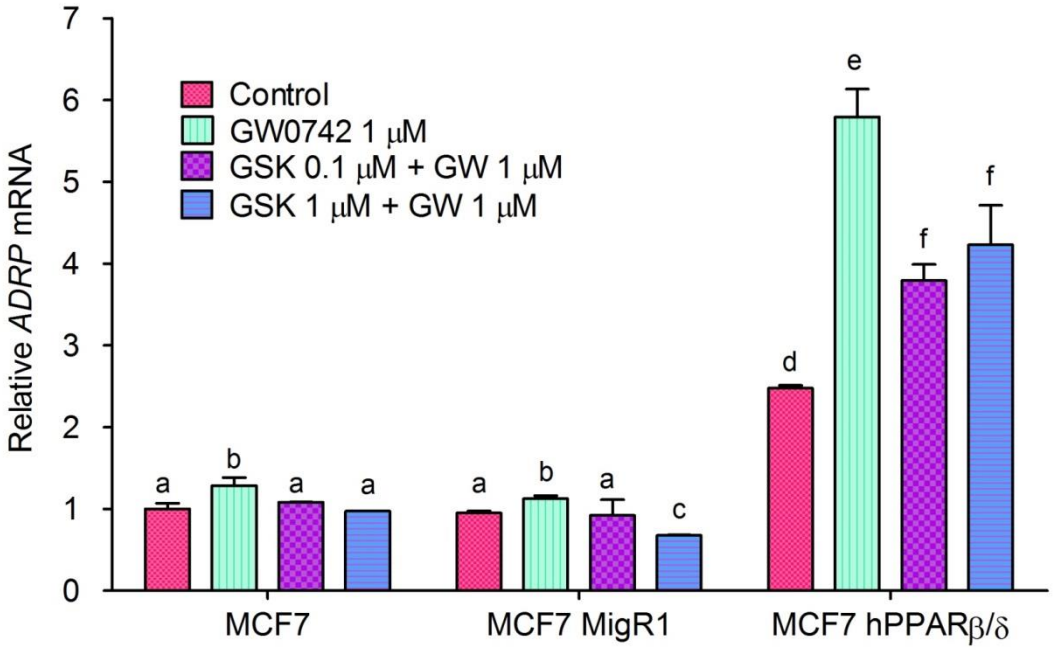


Fig 1. The expression of PPARβ/δ target gene *ADRP* in human breast cancer cell MCF7 following the activation and/or inhibition of PPARβ/δ. MCF7 parent cells, MCF7 MigR1 cells and MCF7 hPPARβ/δ cells were treated with PPARβ/δ agonist GW0742 in the absence or presence of PPARβ/δ antagonist GSK0660 for 24 h. The mRNA levels of *ADRP* and *GAPDH* were determined by qPCR. Over-expression of PPARβ/δ caused the increase in mRNA level of *ADRP*. The activation of PPARβ/δ by GW0742 significantly induces *ADRP* mRNA level in MCF7 hPPARβ/δ cells. GSK0660 treatment suppressed GW0742-induced *ADRP* expression in MCF7 hPPARβ/δ cells. Values represent mean ± SEM of *ADRP* expression normalized to *GAPDH* expression as compared to parent cell line. Significant differences ($p < 0.05$) between groups are denoted by bars with different letters.

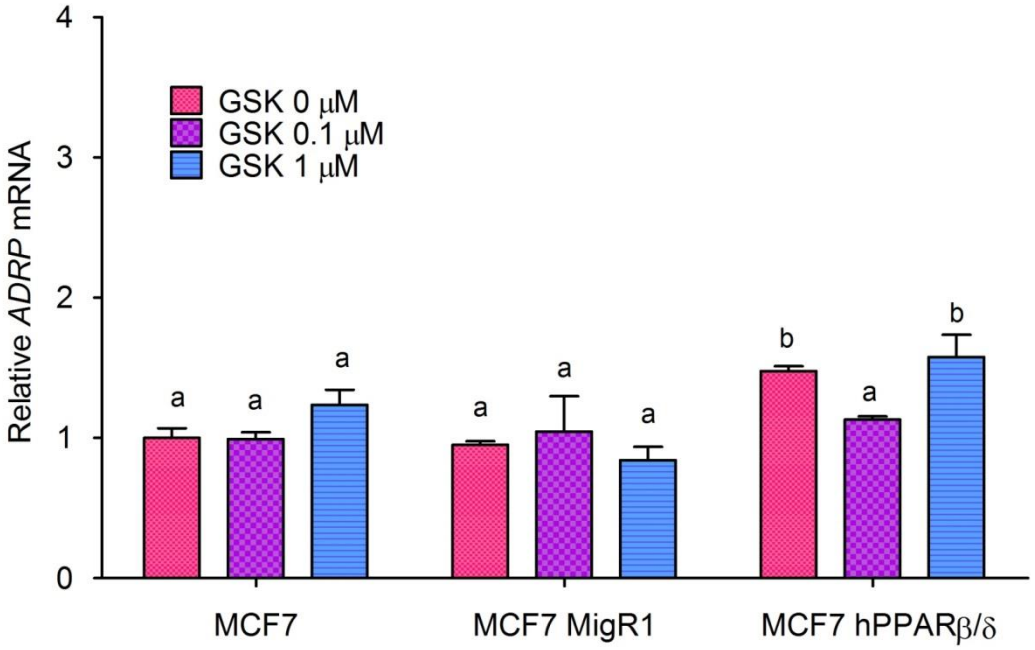


Fig 2. The effect of PPARβ/δ antagonist GSK0660 on the expression of PPARβ/δ target gene *ADRP* in human breast cancer cell MCF7. MCF7 parent cells, MCF7 MigR1 cells and MCF7 hPPARβ/δ cells were treated with PPARβ/δ antagonist GSK0660 for 24 h. The mRNA levels of *ADRP* and *GAPDH* were determined by qPCR. Antagonist GSK0660 did not affect *ADRP* mRNA level. Values represent mean ± SEM of *ADRP* expression normalized to *GAPDH* expression as compared to parent cell line. Significant differences ($p < 0.05$) between groups are denoted by bars with different letters.

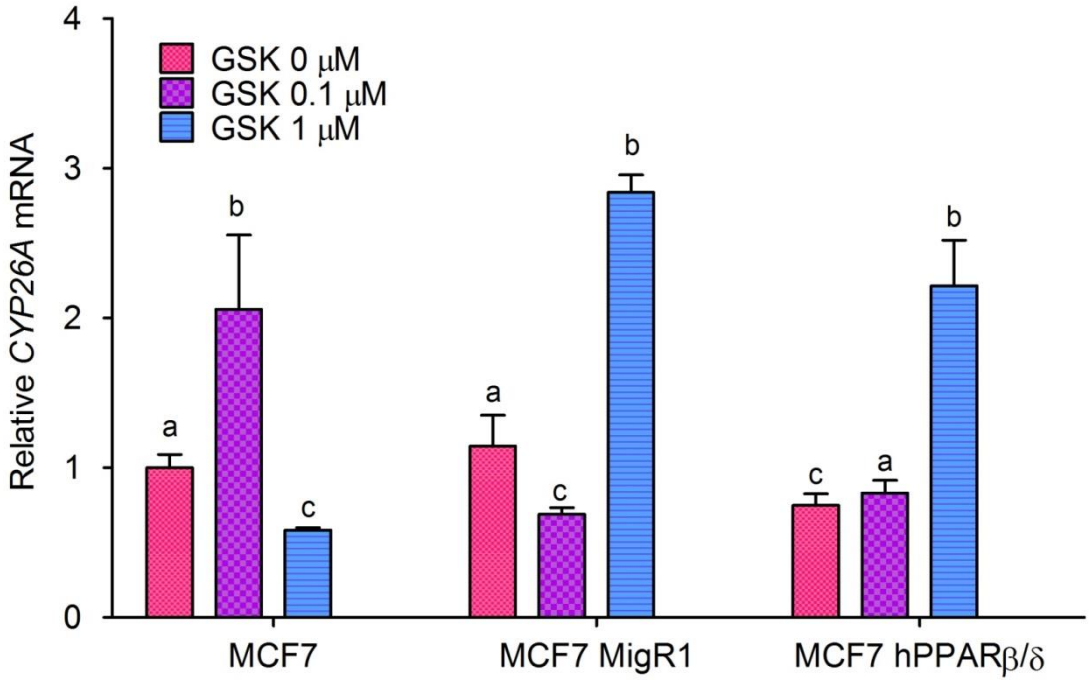


Fig 3. The effect of PPARβ/δ antagonist GSK0660 on the expression of RAR target gene *CYP26A* in human breast cancer cell MCF7. MCF7 parent cells, MCF7 MigR1 cells and MCF7 hPPARβ/δ cells were treated with PPARβ/δ antagonist GSK0660 for 24 h. The mRNA levels of *CYP26A* and *GAPDH* were determined by qPCR. Over-expression of PPARβ/δ decreased *CYP26A* expression. High dose of GSK0660 treatment induced *CYP26A* expression in MCF7 MigR1 and MCF7 hPPARβ/δ cells, while low dose of GSK0660 induced *CYP26A* in MCF7 parent cells. This suggests that the inhibition of PPARβ/δ activity may increase the RAR signaling. Values represent mean ± SEM of *ADRP* expression normalized to *GAPDH* expression as compared to parent cell line. Significant differences ($p < 0.05$) between groups are denoted by bars with different letters.

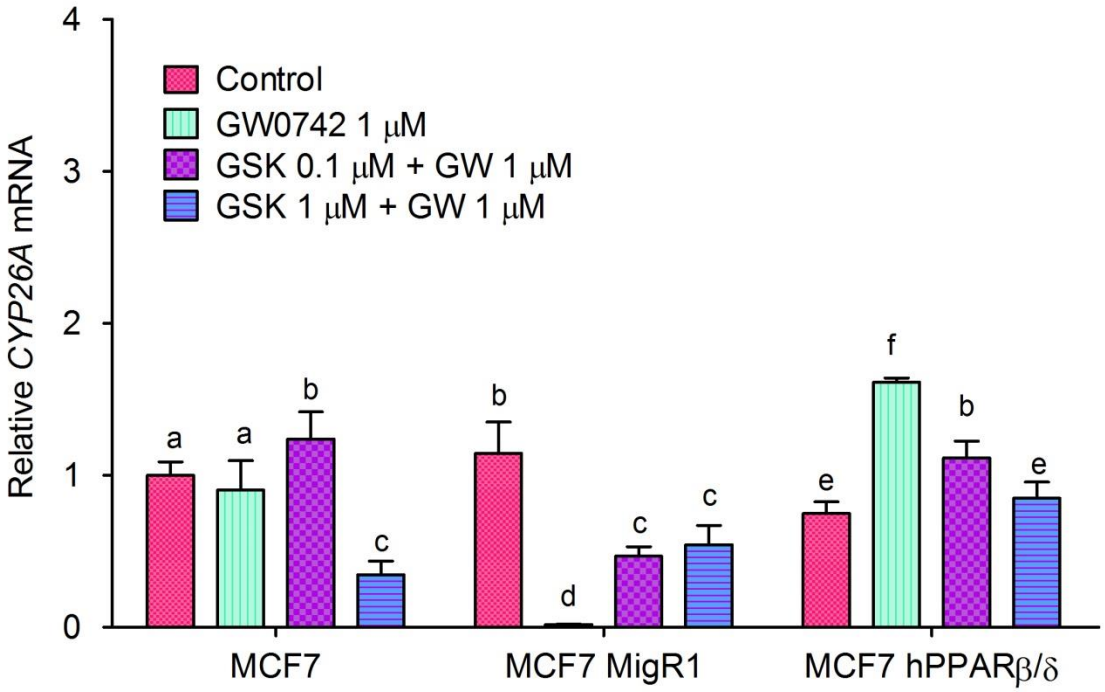


Fig 4. The expression of RAR target gene *CYP26A* in human breast cancer cell MCF7 following the activation and/or inhibition of PPARβ/δ. MCF7 parent cells, MCF7 MigR1 cells and MCF7 hPPARβ/δ cells were treated with PPARβ/δ agonist GW0742 in the absence or presence of PPARβ/δ antagonist GSK0660 for 24 h. The mRNA levels of *CYP26A* and *GAPDH* were determined by qPCR. Over-expression of PPARβ/δ decreased *CYP26A* expression. *CYP26A* expression was decreased in MCF7-MigR1 cells after GW0742 treatment while increased in MCF7 hPPARβ/δ cells. In MCF7 MigR1 cells, GSK0660-induced *CYP26A* expression was inhibited by GW0742 treatment. Values represent mean ± SEM of *CYP26A* expression normalized to *GAPDH* expression as compared to parent cell line. Significant differences ($p < 0.05$) between groups are denoted by bars with different letters.

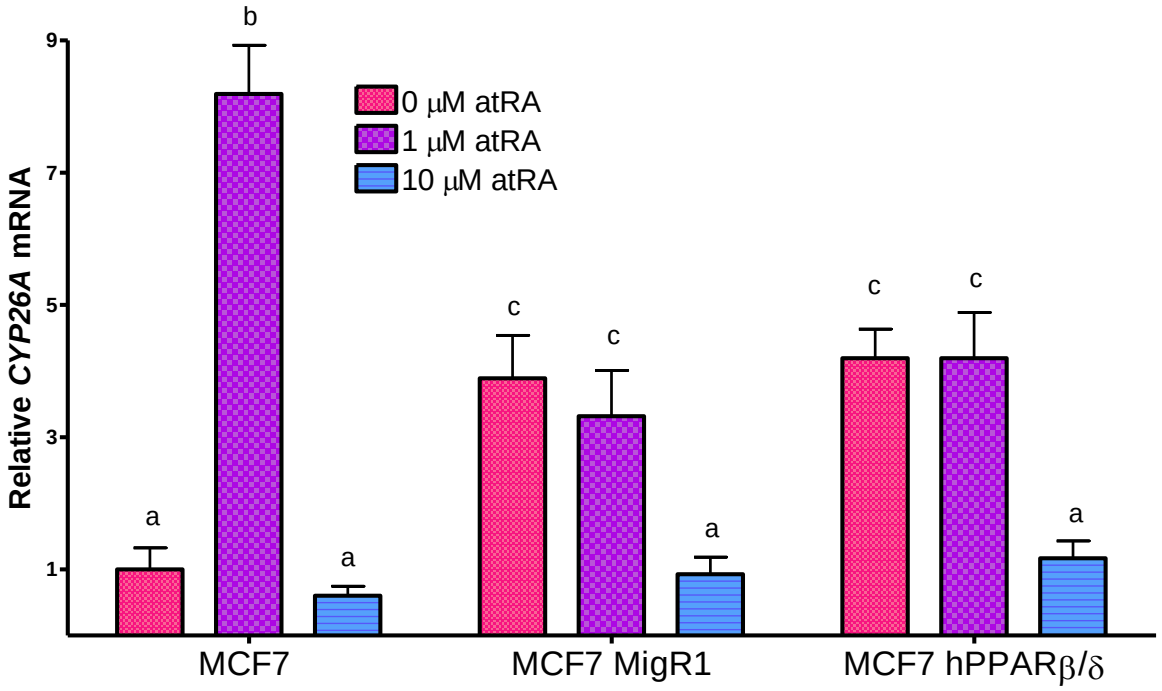


Fig 5. The effect of atRA on the expression of RAR target gene *CYP26A* in human breast cancer cell MCF7. MCF7 parent cells, MCF7 MigR1 cells and MCF7 hPPARβ/δ cells were treated with atRA for 8 h. The mRNA levels of *CYP26A* and *GAPDH* were determined by qPCR. Over-expression of PPARβ/δ decreased *CYP26A* expression. The initial treatment of atRA showed a significant increase in *CYP26A* expression at 1μM concentration in MCF7 parent cells; however 10μM of atRA decreased *CYP26A* expression in both MCF7 cells with low and high expression of PPARβ/δ. Values represent mean ± SEM of *CYP26A* expression normalized to *GAPDH* expression as compared to parent cell line. Significant differences ($p < 0.05$) between groups are denoted by bars with different letters.

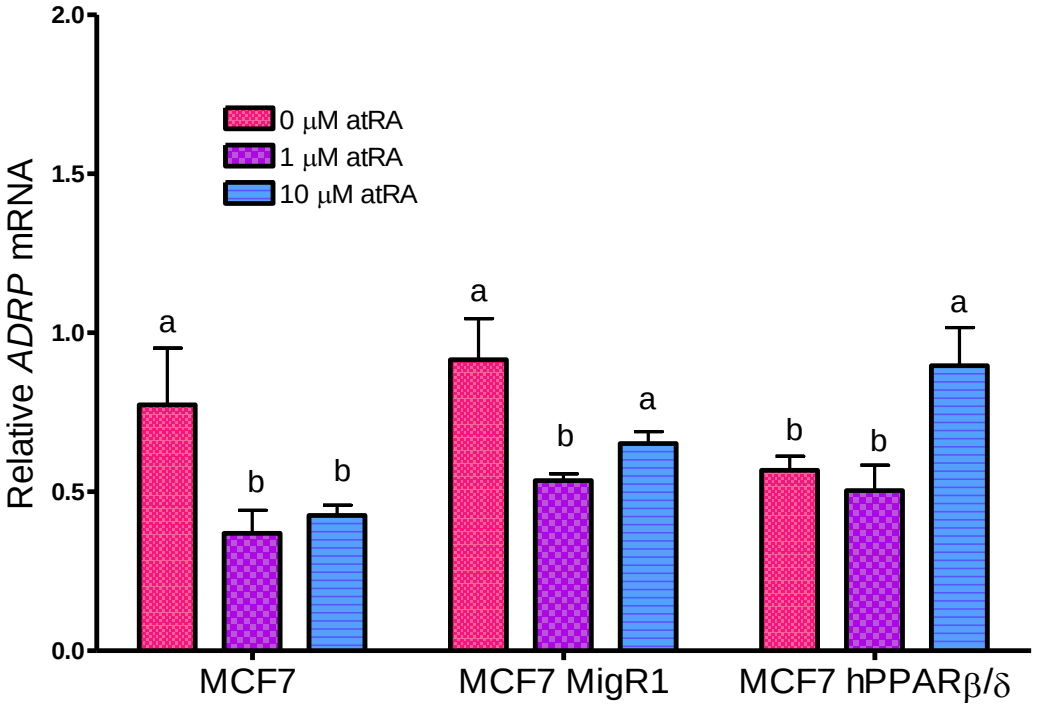


Fig 6. The effect of atRA on the expression of PPARβ/δ target gene *ADRP* in human breast cancer cell MCF7. MCF7 parent cells, MCF7 MigR1 cells and MCF7 hPPARβ/δ cells were treated with atRA for 8 h. The mRNA levels of *ADRP* and *GAPDH* were determined by qPCR. Over-expression of PPARβ/δ decreased *CYP26A* expression. In the parent control cell line and MigR1 cell line, *ADRP* expression went down after atRA treatment; however 10 μM of atRA increased *ADRP* expression in both MCF7 cells with low and high expression of PPARβ/δ. Values represent mean ± SEM of *ADRP* expression normalized to *GAPDH* expression as compared to parent cell line. Significant differences ($p < 0.05$) between groups are denoted by bars with different letters.

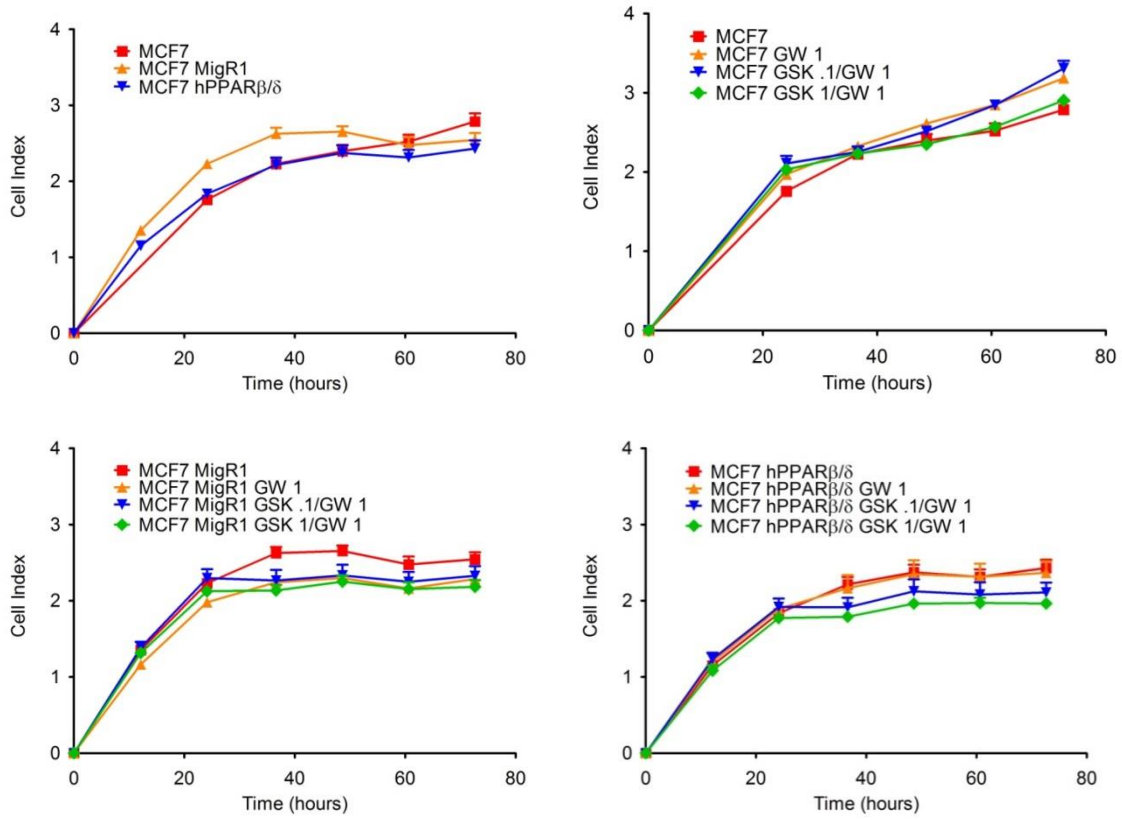


Fig 7. The effect of activation or inhibition of PPARβ/δ on cell proliferation in MCF7 cells. Cell proliferation in MCF7 parent cells, MCF7 MigR1cells and MCF7 hPPARβ/δ cells was measured by xCELLigence System. No significant difference in cell proliferation had been observed among MCF7, MCF7 MigR1, and MCF7 hPPARβ/δ cells. The PPARβ/δ agonist GW0742 and/or the PPARβ/δ antagonist GSK0660 was applied to cells. There is no significant change in any cell treatments

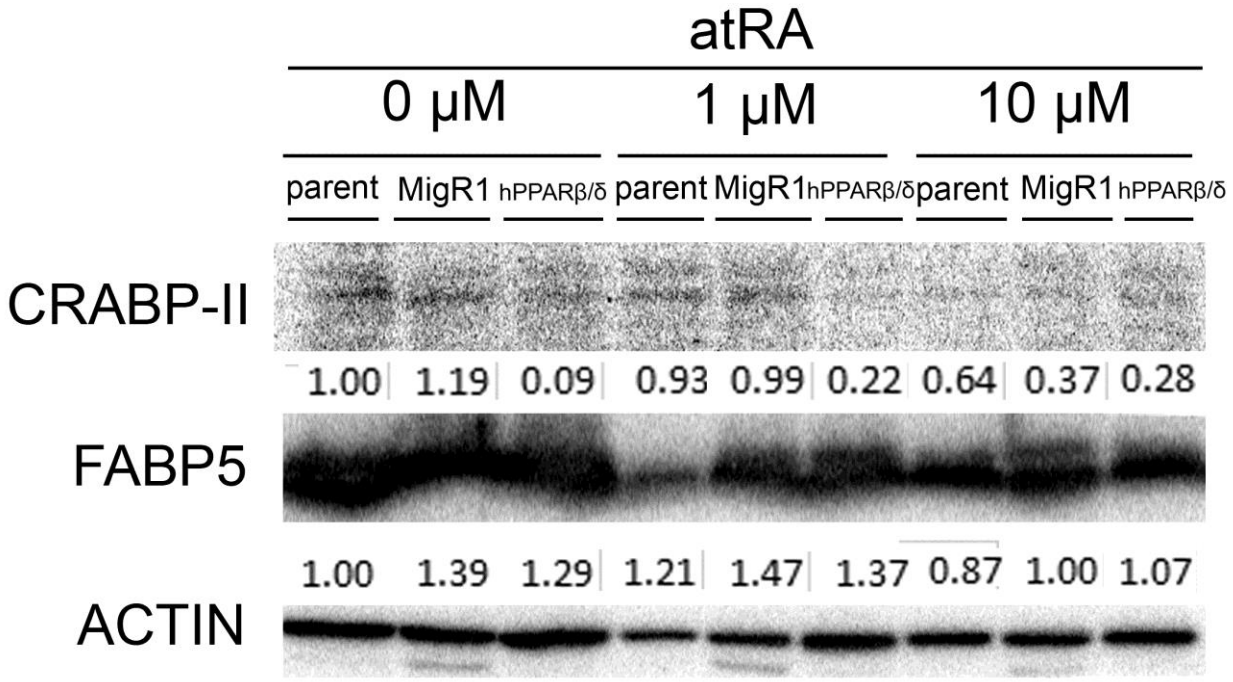


Fig 8. The effect of atRA on the production of CRABP-II and FABP5. There is no significance in the difference in FABP5 or CRABP-II in any of the treatments.

Discussion

To date, the actual function of PPARβ/δ in regulating cancer cell proliferation is still unclear. (1) Here we show that both over-expression of PPARβ/δ and ligand activation of PPARβ/δ by GW0742 increase the expression of the PPARβ/δ target gene, *ADRP,* in the breast cancer cell line MCF7. PPARβ/δ antagonist GSK0660 is able to negate GW0742-induced *ADRP* expression. *ADRP* seems to be a good marker to determine the activity of PPARβ/δ in MCF7 cells. Further using PPARβ/δ agonist GW0742 or agonist GSK0660, we can determine how activation or inhibition of PPARβ/δ influences the growth of human breast cancer cells.

In the xCELLigence test, we can observe whether the increase in PPARβ/δ expression and/or the treatment with GW0742 ± GSK0660 has effects on cell growth in a real-time manner. Other studies in our lab have shown that the over-expression of PPARβ/δ inhibits cell growth in various cancer cell lines, including MCF7 cells. However, our current results showed that no changes in cell proliferation between MCF7 cells expressing either low or high level of PPARβ/δ. In addition, our current results showed the activation of PPARβ/δ by agonist GW0742 has no effect on cell growth, consistent with previous results from our lab. These observations may be due to the fact that the natural ligands present in MCF7 cells compete with the binding site of GW0742 and PPARβ/δ. Our study also showed there was no change in PPARβ/δ activity after strict treatment with GSK0660. The natural ligands of MCF7 already were competing with GW0742 to bind to PPARβ/δ could explain the lack of change in cell growth after the addition of GSK0660.

Surprisingly, the addition of high concentration of atRA has an inhibitory effect on *CYP26A* expression. This chemical imbalance may be responsible for the decrease in *ADRP* expression after high dose of atRA treatment. However, the inconsistent results led to uncertain conclusion whether or not the interaction between PPARβ/δ and RAR occurs in response to atRA. The variability may be resulted from different passages of cells.

Without more than one sample per treatment, the western data needs to be repeated for consistency purposes. Previous studies have examined the effect of atRA on PPARβ/δ at a low ratio and have theorized atRA will take its normal path to the RAR receptor (8). However, after the addition of high concentration of atRA to the cells, the excessive atRA in the cells may have been able to bind to the possibly lower affinity PPARβ/δ. This could explain the increase in *ADRP* expression of the PPARβ/δ over-expressed cell line. Further studies should use an RAR knock-out/hPPARβ/δ over-expressed cell line, using RAR siRNA, to further prove this theory.

Also, our current results showed the activation of PPARβ/δ by agonist GW0742 has no effect on cell growth, consistent with previous results from our lab. These observations may be due to the fact that the natural ligands present in MCF7 cells compete with the binding site of GW0742 and PPARβ/δ. Our study also showed there was no change in PPARβ/δ activity after strict treatment with GSK0660. The lack of change in cell growth after the addition of GSK0660 could be explained by natural ligands of MCF7 competing with the GW0742.

The affect GW0742 and GSK0660 have on the RAR's target gene *CYP26A* are vague. *CYP26A* expression appears to increase when treated with GSK0660, suggesting that RAR signaling has been activated. This cannot be confirmed because the increased expression of *CYP26A* is also apparent in the MCF7 MigR1 vector treated cell line. Without further testing, it cannot be determined whether the over-expression of PPARβ/δ is affecting *CYP26A* expression. The increase in *CYP26A* expression in the MCF7 hPPARβ/δ cell line after treatment with GW0472 indicates the PPARβ/δ agonist also activates RAR. The activation of RAR by GW0742

is also apparent when GSK0660 decreases the GW0742-induced *CYP26A* expression.

Surprisingly, the addition of high concentration of atRA has shown an inhibitory effect on *CYP26A* expression. This chemical imbalance of high levels of atRA may be responsible for the increase in *ADRP* expression after 10μM of atRA treatment.

In conclusion, the role of PPARβ/δ in regulating cell proliferation is still unclear. Instead of directly affecting cell proliferation, the possible change in RAR signaling by PPARβ/δ agonist and antagonist may lead to promoting cell differentiation. Therefore, the differentiation markers should be tested in the future.

Acknowledgements
Special thanks to the Ronald E. McNair Postbaccalaureate Achievement Program for providing the means and funds for this research project.

References

1: Peters JM, Shah YM, Gonzalez FJ. (2012) The role of peroxisome proliferator-activated receptors in carcinogenesis and chemoprevention. *Nat Rev Cancer*. 12(3):181-95.

2: Grigorios Krey, Hansjörg Keller, Abderrahim Mahfoudi, Jeffrey Medin, Keiko Ozato, Christine Dreyer, Walter Wahli. (1993) Xenopus peroxisome proliferator activated receptors: Genomic organization, response element recognition, heterodimer formation with retinoid X receptor and activation by fatty acids. *The Journal of Steroid Biochemistry and Molecular Biology*. 47(1–6): 65-73

3: Borland MG, Foreman JE, Girroir EE, Zolfaghari R, Sharma AK, Amin S, Gonzalez FJ, Ross AC, Peters JM. (2008) Ligand activation of peroxisome proliferator-activated receptor-beta/delta inhibits cell proliferation in human HaCaT keratinocytes. *Mol Pharmaco*. 74(5):1429-42

4: Han S, Ritzenthaler JD, Sun X, Zheng Y, Roman J. (2009) Activation of peroxisome proliferator-activated receptor beta/delta induces lung cancer growth via peroxisome proliferator-activated receptor coactivator gamma-1alpha. *Am J Respir Cell Mol Biol.* 46(3):414

5: Donato LJ, Suh JH, Noy N. (2007) Suppression of mammary carcinoma cell growth by retinoic acid: the cell cycle control gene Btg2 is a direct target for retinoic acid receptor signaling. *Cancer Res*. 67(2):609-615

6: Peters JM, Foreman JE, Gonzalez FJ. (2011) Dissecting the role of peroxisome proliferator-activated receptor-β/δ (PPARβ/δ) in colon, breast, and lung carcinogenesis. *Cancer Metastasis Rev*. 30(3-4):619-640

7: Kittler R, Zhou J, Hua S, Ma L, Liu Y, Pendleton E, Cheng C, Gerstein M, White KP. (2013) A comprehensive nuclear receptor network for breast cancer cells. *Cell Rep*. 3(2):538-51

8: Schug TT, Berry DC, Shaw NS, Travis SN, Noy N. (2007) Opposing effects of retinoic acid on cell growth result from alternate activation of two different nuclear receptors. *Cell*. 29(4):723-33

9: Schug TT, Berry DC, Toshkov IA, Cheng L, Nikitin AY, Noy N. (2008) Overcoming retinoic acid-resistance of mammary carcinomas by diverting retinoic acid from PPARbeta/delta to RAR. *Proc Natl Acad Sci U S A*. 105(21):7546-51

10: Borland MG, Khozoie C, Albrecht PP, Zhu B, Lee C, Lahoti TS, Gonzalez FJ, Peters JM. (2011) Stable over-expression of PPARβ/δ and PPARγ to examine receptor signaling in human HaCaT keratinocytes. *Cell Signal*. 23(12):2039-2050

11: Rieck M, Meissner W, Ries S, Müller-Brüsselbach S, Müller R. (2008) Ligand-mediated regulation of peroxisome proliferator-activated receptor (PPAR) beta/delta: a comparative analysis of PPAR-selective agonists and all-trans retinoic acid. *Mol Pharmacol*. 74(5):1269-1277

12: Palkar PS, Borland MG, Naruhn S, Ferry CH, Lee C, Sk UH, Sharma AK, Amin S, Murray IA, Anderson CR, Perdew GH, Gonzalez FJ, Müller R, Peters JM. (2010) Cellular and pharmacological selectivity of the peroxisome proliferator-activated receptor-beta/delta antagonist GSK3787. *Mol Pharmacol*. 78(3):419-430

Migration, Race and Identity: Arab Migration and its Impact on Cuban Society

Leslie C. Sotomayor, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisors:
Clemente Abrokwaa, Ph.D.
Senior Lecturer of African Studies
The Pennsylvania State University

Solsiree Del Moral, Ph.D.
Assistant Professor of Latin American and Caribbean History
The Pennsylvania State University

Abstract
Extant research on the history of Cuba has focused mainly on the experiences of the Afro-Cubans (former African slaves) brought into the country as a consequence of the Atlantic Slave Trade and their impact on Cuban society. In terms of migration, therefore, very little research exists on the history of the Arab migration into Cuba, which occurred between 1860s and the 1940s. This study focuses on Arab migration into Cuba. Using historical documents and the visual arts of contemporary Cuban-Arab artists I discuss their impact on the socio-economic, political, and cultural aspects of Cuban society. This is an attempt to examine the effects of this migration on race relations, assimilation, and class and identity formation within Cuba.

Section I

Introduction

Purpose of the Study

The purpose of the study is to investigate the impact of Arab migration into Latin America and the Caribbean from the 1860s to the 1940s. Specifically, it will focus on Arab migration into Cuba through an analysis of historical documents and the visual arts of contemporary Cuban and Cuban-Arab artists. The objective of the study is two-fold. First, it examines the causes of this migration and its impact on the Cuban society in terms of race relations, assimilation, socio-economic concerns, and class and identity formation. Second, it analyzes the visual art representations of Cuban-Arab artists, regarding the history and cultural identities of Cuban-Arabs within the Cuban society.

Statement of the Problem

Human migration into new environments alters the established categories of social institutions and the racial and ethnic relations of the societies in which the immigrants resettle. This is the result of the pre-disposed ideas of race, ethnicity, and religious beliefs, as well as identity formation held by the immigrants, which tend to clash with those of the host societies. Cuba was initially composed of indigenous ethnic groups, whose numbers were vastly reduced, leaving a very small population. This, however, produced the introduction of African slaves, Spanish, Chinese, Italians, Austrian, and Swedish among other races into Cuba. The historical contexts of these diverse racial groups, stemming from the Atlantic Slave Trade, Spanish imperialism, U.S. political interference in Cuban affairs, and ties with the former Soviet Union, have created a complex racial composition and identities within the Cuban society. Despite the Cuban Wars of Independence from Spain pioneered by Céspedes and Maceo, in the1860s and based on the ideology of José Martí's "Cuban-ness" which sought to unify all the different races of the country into a homogenous group of one Cuban people, racial and identity formation continues to exist in Cuba today. While a substantial body of literature is extant on the Afro-Cuban experience in Cuban history, little research exists on the history of the Arab migration into Cuba and on the visual arts of the current generation of Cuban-Arab artists and their impact on the Cuban society as a whole. This study aims to fill in the gap left by earlier studies on Cuban history and art.

Significance of the Study

The significance of the study is two-fold. First, it contributes to the body of knowledge on migration, race relations, identity formation and the use of art as a vehicle of record keeping. Second, it hopes to benefit the Cuban-Arab community and visual artists, Art historians, the Cuban government and the people, U.S.-Cuban relations, and African scholars of the Atlantic Slave Trade. It will also benefit historians and researchers on Caribbean history, as well as the educational research institutions and universities specializing on the subject of migration and identity formation.

Hypothesis

Arab migration into Cuba from 1860-1940s has impacted race relations, created new socio-economic and political hierarchies, and added a new dimension of visual art to the cultural mosaic of Cuban society.

Methodology

Data collection for the study included library resources, such as books, journal articles, newspaper reports, films, and documents at the Pennsylvania State University. In addition to data from the author's field research conducted in Cuba from May to August 2012, at the University of Havana, La Casa Arabe (The Arab House), and La Unión Árabe (The Arab Union), plus interviews with Cuban-Arab artists, and information from Internet sources were used.

Research questions

What are the major causes of human migration?
What are the effects of human migration on the societies in which immigrants resettle?
What were the reasons behind the Arab migration into Cuba beginning in the 1860s?

How did the Arab migration impact Cuba's racial, political, economic and other social relations and institutions?
Are there any continued effects of this migration on the Cuban society and its peoples today?
How do Cuban-Arab visual artists portray their heritage within the Cuban culture?

Interview Questionnaire:

1. Why did the Arabs migrate to Cuba?
2. How are Cuban-Arabs perceived as a racial group within Cuban society?
3. Has the Cuban government ever stopped Arab migration into the country? If so, why?
4. Is the Cuban-Arab culture a part of the recognized national cultural heritage of the country? If not, why?
5. How has the Cuban-Arab visual art of the post-1959 Revolution differed from the earlier periods?
6. What are some of the major challenges facing Cuban-Arab artists in contemporary Cuba?

Section II: Literature Review

Theories of Migration, Race and Ethnicity, and Art as a Medium of Historical Record

Introduction

This section reviews the literature on migration, race and identity formation, and the use of art as a medium of historical record to preserve the history and culture of a given people. It is divided into two main parts. The first part discusses the definition of migrant, the theories of migration, and race and identity formation while the second part focuses on the discussion of the literature on the use of Art as a medium of preserving culture and history.

The Definition Problem

The definition of *migrant* has become a complex and contentious issue due to the ever-changing causes of migration and the new experiences and categories of migrants around the globe. For example, since the 1960s, the United Nations has defined a *migrant* as "someone living outside their own country for a year or more."[1] Conversely, Koser rejects this definition, arguing that the term *migrant* encompasses a large variety of people in a multitude of situations, making it difficult to find the amount of data that informs on migrants and determines the length of stay abroad.[2] Furthermore, he asks the question, when does a migrant cease to be a migrant? He argues that the migrant status ends when the person involved decides to return home or becomes a citizen of another country. However, it is evident that both definitions advanced by Koser and the UN appears parochial thus limiting the various identities that migrants may possess. For instance, it is clear that location alone is inadequate criterion to offer as a broader definition of a *migrant*, while Koser's definition, based on citizenship, fails to take into account the enduring psychological impact of being a migrant on those who return to their original countries, as well as those who become citizens of another country. In many ways, those who

[1] Khalid Koser, *International Migration: A Very Short Introduction* (New York: Oxford University Press, 2007), 16.
[2] Koser, *International Migration.*

return to their countries are sometimes perceived by those who stayed either as traitors; strangers or foreigners hence do not truly belong to the society anymore, while those that become citizens of other countries continue to suffer the psychological effects of the longing to return home as well as the cultural and racial discrimination in the new country. Citizenship alone, therefore, cannot be used as the broader definition of the term *migrant* – the psychological impact must be considered in the discourse. In addition, the generations that come after a migrating family in the new country are equally affected by the connections to their ancestral homeland which addition further complicates the search for a single definition of the term. The definition of *migrant*, therefore, appears to encompass a broader spectrum than just location and citizenship as presented above by Koser and the United Nations.

Furthermore, globalization has also created new types of migrants due to the creation of transnational communities or diasporas. According to Koser, diaspora is a broad term historically meaning a forced displacement and inability to return to one's homeland coupled with a yearning to do so.[3] He juxtaposes this definition with Gabriel Sheffer's concept of "having strong ties to the homeland via sentimental and material exchanges, in spite of living in other host countries".[4] Sheffer's definition creates a more inclusive idea of modern theories around diasporas. Another layer to add to these concepts of diasporas is that of psychological borders. Michael Humphrey suggests that, for example, defining an Arab identity involves much more than just a physical inhabitance of space or land, but rather a psychological conversation between past and present.[5] He discusses the potential reasons why, for instance, descendants of Lebanese in Australia, feel a connection and a sense of exile to their homeland, never having been there, or necessarily having a desire to go.[6] The strong adherence to family customs, traditions, and essence of cultural heritage has been stamped into the psychological and nostalgic places of one's psyche occupying a large component of their being. It is these emotional connections, through family and history that move us to have a connection to former lands of our ancestry, all of that being an impact of migration.

According to several scholars including Andrea O'Reilly Herrera, Gloria Anzaldua and bell hooks, these psychological spaces expand through multiple experiences and analyzed through compilations of stories, testimonies, and visual arts and artists, of individuals on the fringes of borders, whether physical or psychological or both. All of these categories are blurred and overlapped and the labels of *a migrant* can change at any time due to any of these reasons. The complexities of these terms and categories therefore, are layered definitions of one's experience and the globalization of these migratory patterns. It is evident therefore, that there is no single universal definition of the term *migrant* due to the complexities of the conditions involved. The notion, concept and causes of migration and the production of the migrant continue to evolve as dictated by social, economic and political concerns of nations and the international community.

This study defines a *migrant* as "someone living outside their own country legally or illegally, and practicing a minority culture, language and affiliated with a distinct ethnic minority group or community."

---

[3] Koser, *Intenational Migration*, 48.
[4] Koser, *International Migration*, 25.
[5] Michael Humphrey, "Lebanese Identities: Between Cities, Nations, and Trans-Nations," *Arab Studies Quarterly* 26 (2004): 31-50.
[6] Humphrey, "Lebanese Identities."

Theories of Migration

Two main theories underlie the concept of migration, namely, the *push and pull* migration factors and the *coercive* migration theory.

The Push and Pull Migration Factors

The literature on migration advances three main theories on the subject: the voluntary, involuntary, and the coercive migration models. The voluntary migration theory focuses on the "push and pull" factors dictated by the rational choices of migrants, and based primarily on wage differentials between countries,[7] Higher economic incentives elsewhere, are capable of pulling migrants into that economy, while depressing economic conditions at home rather push migrants to flee such conditions for a better life elsewhere. The depressing economic conditions in a country's economy are the result of a lack of adequate capital accumulation for local or domestic investments to expand the economy to create more jobs for the growing workforce of that country. This situation creates high unemployment rates among the workforce and with no assurances of a better future, migration to other promising economies becomes the only option left for the citizens involved, with the belief that they will be able to return home someday after accumulating some capital for themselves and their families, or have the means to be able to send in remittances to assist their families back home. For example, Cuban-Americans often send money to their families in Cuba to assist with their living expenses in the depressed Cuban economy. The push and pull migration theory, is thus premised on what Massey has termed "bearable conditions of life."[8] He explains this concept to mean the supply of basic needs of life such as healthcare, food, shelter, employment, and access to good education.

The *involuntary* migration theory, on the other hand, argues that migrants leave their own countries of origin, or cross international borders based on their own accord. Those who leave voluntarily and acquire proper documents to enter the new country are termed *legal* migrants, while those who enter other countries without proper documentation and permission through the established legal channels are termed *illegal* migrants. This model thus creates two distinct groups of migrants defined mainly, by their legal status in the new country rather than by the fact that they live outside their own countries.

The Coercive Migration Theory

The coercive migration theory determines two types of migrants: the reactive fate groups and the purpose groups. The reactive fate groups are those who leave their countries with no plans on how they will return, as in the case of civil and ethnic war victims or victims of an environmental disaster, such as a volcanic eruption or flooding caused by a tsunami or dams. The purpose groups, on the other hand, are those who leave their countries of origin to organize resistance for eventual return, using the host country as a base. Several freedom fighter groups around the globe thus making the theoretical suppositions of migration and migrants a historical consideration have used this migration model.

A study of the two theories indicates that both are similar in the causes that underline migration and the production of a migrant. While severe domestic economic conditions act as levers to push and pull desperate migrants into the more stable and developed economies of the

---

[7] T. Faist, et al (eds), International Migration Immobility and Development. New York: Berg Publications, 1997.

[8] Douglas S. Massey, Joaquin Arango, Graeme Hugo, Ali Kouaouci, Adela Pellegrino and J. Edward Taylor, *Worlds in Motion: Understanding International Migration at the End of the Millennium* (Oxford: Clarendon Press, 1988).

industrialized societies of North America, Europe and Japan, from Africa, Asia and the Caribbean, including Cuba, other migrants whose countries are afflicted by war and natural disasters are also desperately trying to migrate into more stable societies to have a better life.

Theories of Ethnicity and Race

On the topic of race and ethnicity, Castles and Miller advance a framework of theories and migratory processes that analyze race, gender and class, and citizenship in relation to ethnicity and racism.[9] Migration and settlement are closely tied to other themes of economic, political, and cultural linkages being formed between countries throughout the process of globalization. The most common outcome of migratory movement is the establishment of communities of ethnicity and minorities in the new country. The term *ethnicity* is a complex one with many varying definitions across multiple interdisciplinary spheres. However, Castles and Miller, conclude that regardless of the varying definitions of ethnicity, the implications are:

> [Ethnicity] leads to identification within a specific group, but its visible markers-phenotype, language, culture, customs, religion, behavior may also be used as a criteria for exclusion by other groups. Ethnicity only takes on social and political meaning when it is linked to process a boundary between dominant groups and minorities."[10]

Ethnic *minorities* and the process of their formation are two parts, according to Castles and Miller, namely, their own self-definitions (consciousness of group members) and their "othered" definitions (ascription of undesirable characteristics as an inferior people), by the host country. Self-definition also has two parts within it being assertion of ethnic identity based upon pre-migration cultural symbols, practices, and traditions/norms *or* seeks inclusion in the new host country by assimilation and the interpretation of these cultural symbols and practices. This can be highly politicized when the re-settlement and ethnic minority identity formation is taking place during economic and social crisis.[11]

This ethnic impact is not only for the settler, but for the host society as well. Issues of identity, culture, and community come to light in order to form a common space with incoming migrants. For example, the communities of Arab migrants in Cuba have established close-knit groups to identify with their homeland, and introduced Arab foods, traditions, and customs into the Cuban society. However, this practice by the new migrants may in turn challenge the established homogenous norms in the host society. An order of racial, class and gendered hierarchy may be established, as seen with Africans coming into Cuba as slaves, and such migrants are automatically placed into the 'othered' social group by the dominant majority due to their slave status.

However, a question that needs to be answered is: why do some migrants take on the character of *ethnic communities* as opposed to *ethnic minorities*? According to Castles and Miller, phenotypical differences are a general factor as a marker for minority status.[12] The two authors provide four potential reasons, namely: phenotypical difference may coincide with recent arrival, cultural distance, socio-economic position or target for racism. Depending on the given

---

[9] Stephen Castles and Mark J. Miller, *The Age of Migration: International Population Movements in the Modern World.* Second Edition. (London: MacMillan Press LTD, 1998).
[10] Castles and Miller, *The Age of Migration.*
[11] Castles and Miller, *The Age of Migration,* 46.
[12] Castles and Miller, *The Age of Migration.*

environment, an individual will either ally with ethnic *communities* that share a common bond or become an ethnic *minority*, as they are unable to find a space in the community to bridge the gap.

From the four categories of the rationales of migration stated previously, *permanent settlement* evolves the *ethnic community*, seen as part of a multicultural society, or *ethnic minorities*, whose presence is widely disregarded. The first, *ethnic community*, would be established by the migrant and their descendants as an integral part of society, willing to reshape its culture and identity, while the second, *ethnic minorities*, migrants are excluded and marginalized, living on the fringes of a society via a homogenous identity. They have been 'assigned' a subordinate position in society by the dominant groups, and have some degree of collective consciousness.[13]

The concern of dominant groups has been the threat of being outnumbered by in-coming migrants. The formation of these ethnic *communities*, that offer solidarity and a sense of community for the migrants, is viewed as a challenge to the homogenous society, or as regressive. However, ethnic *minorities* may be seen as resisting the homogenous identity by actively engaging in a collective consciousness. For instance, linguistic and cultural maintenance may be seen as proof of this but the host society may view this as an opposition to national identity formation.

Castles and Miller, define racism as "[M]aking and acting upon predictions about people's character, abilities, or behavior on the basis of socially constructed markers of difference."[14] Racism or *institutional racism* is upheld in society by the national and local structures that support it, such as laws, policies and administrative directives that discriminate against the dominated group.[15] Institutional and informal discrimination has largely contributed to the migrant's disadvantage in the work place, further marginalizing groups into low-status work, high unemployment, negative working conditions and lack of opportunities. The exclusion of certain groups in mainstream society is an example of marginalization. If culture is defined, as Castles and Miller explain, in terms of language, religion, and values this will have a bearing on the cultural distance of the settler in their host country.[16]

Phenotypical difference coincides with socioeconomic status, as some migrants from less-developed countries will lack the skills and education found in industrialized economies. Low socioeconomic status is a result of marginalization and a cause of minority status. The most significant reason then for the cultural distance and minority formation is that the dominating population and the state (nation/country) of the host country are causing the discrimination. Castles and Miller refer to this as *racism* and the results as *racialization* of minorities.[17] The practice of racism and discrimination against migrants compels such groups to develop survival methods in attempts to preserve their cultures using various methods, including art.

Migrants and the Use of Art in the Diaspora

The formation of ethnic minority communities in the host country resulting in the creation of a diaspora outside the migrant's original country or homeland encourages the introduction of new cultural practices, music and dance, cuisine, customs and various forms of art into the new country. The migrant community uses this enclave within their host society as an

---

[13] Castles and Miller, *The Age of Migration.*
[14] Castles and Miller, *The Age of Migration, 38.*
[15] Castles and Miller, *The Age of Migration*.
[16] Castles and Miller, *The Age of Migration.*
[17] Castles and Miller, *The Age of Migration*.

opportunity to establish their identity and cultural heritage which also provides them with a form of cultural capital in their new country. They desire to continue to remain attached to their original homeland and this remembrance manifests in various ways, including the use of art.

In her book, *Art on My Mind,* bell hooks, discusses the importance of art in culture and society, as well as the weight it carries not only as a vehicle of expression but also as a means to offer a pool of reflection, and a space for dialogue and activism.[18] She emphasizes the point that the importance of art lies not only in the act of creating art but of also discussing, experiencing and having access to art; it is a realization that art is *needed* for our well-being. She speaks about art being shown in segregated spaces, not in inclusive public spaces. This, according to her, has been evident, for example, in African American culture, where African or African-American art has not been incorporated into mainstream society but designated its own enclave within a segregated space. Furthermore, she notes that in U.S. history, African art was displayed in segregated black communities, but this, she argues, is not enough to make an intervention or revolutionized collective art experience. According to her, we, as human beings, come to recognize the familiar in life, and if art - visual art - is not the familiar, it can leave us dissatisfied. She contends that in order to identify with art, a shift must occur that changes the way we see and look at art. One of the ways she proposes for this to occur, is through critical education that the creation and public sharing of art is essential to the practice of freedom, as she states "…we must set our imaginations free."[19]

Bourriaud, explains the process of identity formation in the context of modernism through art. He states that the fundamental concepts of twentieth century avant-garde art have the commonality of a 'passion for radicality,' being the elimination of everything in order to return to the 'first beginnings or principles.'[20] The fundamental concept that modern art "elaborates a metaphysics of the root or a desire to go back to the beginning, and to start again and create new language, free of its detritus" is precisely the starting point in order to establish the connection to today, in twenty-first century globalization.[21] The *radical* is thus implicit of eliminating, subtracting, and creating a clean slate in its simplest form, while a *radicant,* is a *system of roots*. This differentiation is critical to Borriaud as he contends:

> And yet the immigrant, the exile, the tourist, and the urban wanderer are the dominant figures of contemporary culture. To remain within the vocabulary of the vegetable realm, one might say that the individual of these early years of the twenty-first century resembles those plants that do not depend on a single root for their growth but advance in all directions on whatever surfaces present themselves by attaching multiple hooks to them, as ivy does.[22]

In keeping with Bourriaud's definition of a *radicant* and also that of the *migrant* above, the definition of art thus must encompass a wider psychological framework to include not only the experiences of the artist but also of his/her psychological past and present. In other words, an artist working in the present time, may also be creating a new dimension of culture, past or present, because of the psychological spaces that he/she may be inhabiting as they are

---

[18] bell hooks, *Art on My Mind: visual Politics (New York: The New York Press, 1995).*
[19] Bell Hooks. *Art on My Mind Visual Politics*. (NewYork: The New Press, 1995), 4.
[20] Nicolaus Bourriaud. *The Radicant*. (New York: Lukas and Sternberg, 2009).
[21] Bourriaud. *The Radicant*, 44.
[22] Bourriaud, *The Radicant,* 51.

interacting between worlds and cultures. This hyphenation or hybridity is a form of mapping and expands beyond what Bourriaud (2009) explains with geography as *psychogeography.* His definition of a *radicant* as working within a structure of roots, conforming and adapting to various geographical surfaces as a means of connecting with its environment and any forces of uprooting it encounters, confirms the nature of the artist working within this realm. This would then imply, according to Bourriaud, "a negotiation of identity" and the 'other' as translations are given and received within geographical and psychological spaces. It is within these spaces that the diasporic artist is born and who establishes the ties to his/her family's cultural heritage and ancestry using their work to record, collect and add threads of memory and desire to connect to what was and the remnants of what is.

Art in the Diaspora

Benítez-Rojo likens multiple and 'erratic' readings of the Caribbean, as similar to Columbus and his judgments, which are mostly filled with foreign purposes and depicted as fragmented and inconsistent.[23] He revisits with new lenses that would suggest a paradigm shift in the way we view the islands geographically and historically. He further explains, that his observations are more closely akin to the scientific research discipline of *Chaos*.[24] This un-linear concept of analyzing history and its effects, the disorganization, as compared to nature, offers a dynamic of the possibility of repeating itself, in spite of the disorder, just as seen through nature. Benítez-Rojo explains:

> Chaos looks toward everything that repeats, reproduces, grows, decays, unfold, flows, spins, vibrates, seethes; it is as interested in the evolution of the solar system as in the stock market's crashes, as involved in cardiac arrhythmia as in the novel or in myth. Thus Chaos provides a space in which the pure sciences connect with the social sciences, and both of them connect with art and the cultural tradition. Of course, any such diagrammatic connections must suppose very different languages and a communication that is hardly ever direct, but for the reader who is attuned to Chaos, there will be an opening upon unexpected corridors allowing passage from one point to another in the labyrinth.[25]

The analyses of these cultural phenomena are not for the purposes of finding 'answers' or end products but for the processes that develop throughout and within marginalized and diverse communities.

Herrera created and developed the term, Cub*ands* as an elastic inclusive word interweaving Cuban and exile discourse.[26] The terminology recognizes the multitude of nations that create the Cuban culture, allowing for complex identities. Antonio Benitez-Rojo concentrates on the study of "the poly-rhythmic cultural repetitions" or constant, specifically with Cuba, that has occurred outside the island.[27] *Repetitions*, is a term meaning 'aftershock',

---

[23] Antonio Benítez-Rojo, *The Repeating Island: The Caribbean and the Postmodern Perspective.* Second Edition. (Durham and London: Duke University Press, 1996).
[24] Benítez-Rojo, *The Repeating Island, 2.*
[25] Benítez-Rojo, *The Repeating Island, 3.*
[26] Andrea O'Reilly Herrera. *Remembering Cuba: Legacy of Diaspora* (Austin: University of Texas Press, 2001). First Edition.
[27] Benítez-Rojo, *The Repeating Island.*

and in this context, Benítez-Rojo uses it to describe the post-production of art and Nicolas Bourriaud expands on this meaning:

> [T]he work of art is an event that constitutes the replication and reply to another work or a preexisting object: distant in time from the original to which it is linked, this work nonetheless belongs to the same chain of event.[28]

Herrera builds upon this concept of Benítez-Rojo's, by adding the British Romantic concept of 'the spiral return,' which posits that during a voyage we are permanently altered, and unable to return to a place of origin in the exact psychological, emotional or physical state.[29] The experiences that have marked, transformed and evolved us have done *something*. What do these alterations mean? What impact do they have on art? Bourriaud states, "…works are in dialogue with the contexts in which they are produced."[30] Therefore taking into account the contexts that have influenced the artist and their creations is essential in understanding the current conditions in which they are created. We can also infer that the formation of culture and society is in flux because of these migrations, travels and mixtures of cultures, thus creating spaces that are new.

Similarly, Humphrey discusses the potential reasons why, for example, descendants of Lebanese in Australia feel a connection and exile to their homelands, despite the fact that they have never been there, or necessarily having a desire to go.[31] It is these emotional connections through family and history that move us to have a connection to former lands of our ancestry. These psychological borders that exceed physical space are akin to the mapping of the self or identity.

Identity and Mapping in Art

The concept of mapping oneself is not singular, it may feel singular as the body which produces the art, or experiences the pain, the isolation and the estrangement, but it is multiple, as it overlays in a variety of interwoven realities as a form of mapping one's identity. Mapping has historically been used to categorize or locate places, resources, or ways to get from point A to point B; it would have a scientific maritime premise to its core, in order to have complete accuracy in navigation, or as a locator of resources and for war tactics.[32]

Mapping is a form of interweaving of the past, the present and the potential future of the human race. As an individual work, mapping one's self is what the artist does in isolated places for one's identity but also as a collaborative work. It is the process or means of connecting through various forms, or *inter-forms*, that link together, as Bourriaud explains:

> The cultural object-larval, mutant, letting its origin appear under the more or less opaque layer of its new use or of the new combination in which it happens to be captured-no longer exists except between two contexts.[33]

---

[28] Bourriaud. *The Radicant*.
[29] Andrea O'Reilly Herrera, *Cuban Artists Across the Diaspora: Setting theTtent Against the House* (Austin: University of Texas Press, 2011).
[30] Bourriaud, *The Radicant*,8.
[31] Humphrey, "Lebanese Identities"
[32] Arthur Hunt, "2000 Years of Map Making," *Geography* 85, No.1 (2000): 3.
[33] Bourriaud, *The Radicant*, 156.

This multiplicity of contexts exceeds any pre-determined category while on the other hand it is a singular experience, at a given time in history, which will not recur.

An example of 'mapping' oneself and invisibility in art culture may be found in the works of Ana Mendieta (b.1948-1985), a Cuban-American performance artist, sculptor, painter and commonly referenced as a leading artist in "earth-art." Although her works have become more widely known posthumously, Mendieta's work stands as a form of documentation and mapping of identity, cultures, dislocation and negotiations in the in-between places. Her series, *Siluetas*, on exhibit at the Museo de Bellas Artes, edificio de Arte Universal in Havana, were found to evoke conversations, as observed by the author during her field research in Cuba. Her images conveyed feelings of displacement and tension between the lost and the search for the reclamation of her identity. Her performance and pieces of photographs in her birth country, Cuba, offers a connection of earth, body and displacement themes as documentation of her consistent attempt to mapping herself.[34] Mendieta's personifications through geography, as she carves, burns, builds, and uses her body to mark the earth, encompass the spiritual and psychological connections to the land and "[H]er art still bears the cultural imprint of her motherland, but for the artist it resulted in a continuous form of loss and not a claim of the original culture."[35] Her varied attempts to connect through Cuban legends and myths, imprinting her physical body on the earth (as mother), creating art throughout her various places of residency in the U.S. and abroad, speak to her uneasiness and yearning for her homeland of Cuba, from which she was exiled.

In a similar fashion, the artwork of Luis Álvarez Pupo titled *Caminos Errantes* (*Wondering Ways*) displayed at the La Unión Árabe in Havana was also observed to speak of themes of migration and identity. Through photographic pieces his works compile scenes and data that speak to migration and the back and forth movement of individuals. Close up photographs in black and white large prints line the walls of the gallery, as it takes a minute to decipher the cropped images of water, views through chain-linked fences, footprints, and hair and skin. The photographs allude to the struggles of migration and migrants and the harsh realities of the elements that are experienced by the migrant, and the uncertainty of these moments.

Conclusion

This section reviewed the literature on the theories of migration, race and identity formation. It was discovered that based on the evolutionary nature of society and national and global economies, there can be no single universal definition of a migrant. Instead, such a definition should encompass a multitude of perspectives inclusive of physical location, psychological and legal status. Additionally, it was ascertained that migrants created ethnic communities, as a form of solidarity and also for cultural preservation. It is also the retention of the values and connections to the original ancestral homelands. This preservation is achieved through several ways, including the use of art. While the dominant or host society could also perceive these communities as ethnic *minorities*. The creation and use of the term of ethnic

[34] Amanda Boetzkes, *The Ethics of Earth Art* (City: University of Minnesota Press, 2010).

[35] Muge Ozbay, Inci Eviner, Tevfik Akgun, "Aesthetics Bridging Cultures:Deterritorialization, Performative Identity and Uncanny Representation of Woman's Body in the Works of Ana Mendieta," *Congress of Aesthetics* (Istanbul: Yildiz Technical University, 2007).

minorities could then develop into dominant/subordinate or superior/inferior racial groupings, within the host country and migrant groups.

The next section discusses the Arab migration, Arab communities and its impact on Cuban society.

Section III

Arab Migration into Cuba and Its Impact on Cuban Society

Introduction

This section discusses the Arab migration into Cuba and its impact on the Cuban society. The topics discussed include a brief history of Cuba, the development of Arab migrant communities, the classification of Arab migrants, and an analysis of the visual art contributions of Cuban-Arab artists.

A Brief History of Cuba

Cuba is the largest island country in the Caribbean, with a population of over 11 million people. Havana is the capital city, followed by Santiago de Cuba as the second largest city. It is a racially diverse country formed by Spaniards, indigenous groups, African descended peoples, and migrants including Chinese, Europeans and Arabs. In 1492 Christopher Columbus claimed Cuba as a colony of Spain, and this claim lasted until 1868 when Carlos Manuel de Céspedes and Antonio Maceo began the Cuban Wars of Independence through 1878, which finally, led to the Spanish-Cuban War of Independence in 1898. The United States allied itself with Cuba in the latter's fight for its independence which also marked a significant shift in Cuba's Independence because U.S. took over Cuban government. In 1902, the U.S. sanctioned the Platt Amendment and the Cuban Constitution was implemented until 1930, that year Gerardo Machado overturned it, marking an end to the neo-colonialism by the US concerning Cuba's Independence. Following a succession of 'puppet' presidents, the Cuban Constitution of 1940 was instated and Fulgencio Batista, the first non-white president of Cuba was elected. However, in 1959, Batista fled into exile as a result of the Revolution staged by Fidel Castro, Raúl Castro and Che Guevara. Since 1959, the Cuban political philosophy has been based on Communism and Socialism. The country's economy is based mainly on the export of nickel, mattes, raw sugar, cigars, medicaments, and alcoholic preps for beverages while it imports rail locomotives, soybean, wheat, meslin, and corn seed. Its trade partners include China, Venezuela, Brazil, Canada, Argentina and Spain.[36]

Arab Migration into Cuba: 1860-1940s

At the beginning of the 1860s, Arabs began to migrate into Cuba from Lebanon, Syria, Palestine, Turkey, and Egypt. By 1900, over two thousand Arabs had migrated to Cuba. During the period 1920-31, the government census report indicated that there were over 9,000 Arabs migrants in Cuba from the Mediterranean region.[37] According to Menéndez-Paredes, these

---

[37] Rigoberto Menéndez-Paredes, "Parentesco y tradicionalidad: un estudio étnico-social de los inmigrantes árabes de Cuba (1870-1957)," *Misceláneas de estudios árabes y hebraicos. Sección Árabe-Islam* 49 (2000): 89-103.

migrations were caused by the economic decline of the period as consequence of the fall of the Ottoman Empire.[38] It is important to note that before 1910, the national identities of the migrants entering Cuba were classified as either Syrian or Turk, at the point of entry into Cuba, but this changed into Lebanese, Syrian and Palestinian after 1910. In 1892, Q. Gallostra served as General Ottoman's Consul in Cuba. He was the first to document both the Arab and Turkish migrants that entered Cuba during this period and which later developed the need for such continuous documentation of in-coming Arab migrants.[39]

According to Alfonso Farnos and Sonia Catasus, Arab migration occurred in three stages. The first wave occurring during the period 1860-1930, the second wave from 1930-58, which marked a balance of net migration and coincided with the neocolonial Cuban crisis. The third wave occurred following the changes introduced by the 1959 Revolution.[40] From the period 1923-25, a high influx of Arab migrants entered Cuba, especially due to the tightened immigration laws of North America. During the second stage of the migration in the 1940s, the numbers were low but it increased towards the beginning of the decade primarily, because of agriculture and the commercial activities of the Shiites of Southern Lebanon who migrated to Cuba for economic reasons, as they felt less privileged within independent Lebanon.[41]

The main entry ports for the migrants were Santiago de Cuba, Cienfuegos and Havana. In 1906, the country's immigration law remodeled the ports that existed to put the incoming migrants into zones where agricultural labor was needed. During the period of 1940-50s, a third wave of Arab migration occurred with most of them coming from the Middle East. Therefore, three main waves of migration occurred during the period of 1860-1940s, marking an influx of Arabs migrants coming into Cuba.

Categories of Arab Migrants

Euridice Charon classified the migrants from 1902-36 as Arab, Turkish, Syrian and Egyptian thus concluding a quantitative demographic categorization to ascertain migration from the Middle East into Cuba.[42] However, the unpublished census of 1931 report, which revealed the time period when actual origins of migrants were recorded. They were from Lebanon, Palestine, Syria, and Arabia.[43]

However, this classification of migrant origins becomes problematic. Initially most Arab migrants into Cuba were seen as Syrian. This was due to the geography of the region before it was divided into separate states that today indicate Lebanon, Syria, and the territories of Egypt and Turkey, as a consequence of European colonization. Therefore, those born before this time were in a region governed by Syria.

A further complication of the issue is that the travel and archival classification documents were designated as Lebanonese, Syrian, Asiatic, Turkish, Nazarian, and Asia Minor.[44] The only exception was that of the Egyptians, where no border identification occurred to infringe upon

---

[37] Rigoberto Menéndez-Paredes, *Los árabes en Cuba* (La Habana: Publicaciones de la Oficina del Historiador de la Ciudad, 2007).
[38] Menéndez-Paredes, *Los árabes en Cuba*.
[39]Menéndez-Paredes, *Los árabes en Cuba*.
[40]Menéndez-Paredes, *Los árabes en Cuba, 70.*
[41]Menéndez-Paredes, *Los árabes en Cuba*.
[42]Charon Euridice, "El Asentamiento de Emigrantes Árabes en Monte (la Habana, Cuba), 1890-1930," *Awraq: Estadios sobre el mundo árabe e islámico contemporáneo* (1992).
[43]Menéndez-Paredes, *Los árabes en Cuba*, 45.
[44]Menéndez-Paredes, *Los árabes en Cuba*, 58.

national identity. These classifications are complex because there may have been various denominators involved in order to determine Arab migrants' identities. For example, their citizenship, residency, religion, or ethnic identity could all or partly be used as a means of identification. Furthermore, these classifications correspond with the geographical regions of the Ottoman Empire that was in existence until 1918. Amin Maalouf explains how these identifications can be very complex. For example, a migrant's status could be recorded as: State: Turkey; Language: Arabic; Province: Syria; Country: Monte Lebanese (Monte Libano).[45] They were further classified through the registry of last name, and the translations from the Arabic language to that of Spanish could have had potential errors in the translation process.

The Development of Arab Migrant Communities

The growth of Arab migrant communities occurred in Monte, Havana where they set up community centers, businesses and stores and established themselves as merchants, jewelers, and doctors, and members of Cuban society. This also created future opportunities for the second generation Cuban-Arabs, enabling them to secure professional status, especially in the sciences, medicine, law and politics. The first generation of migrants were merchants who could afford better education for their children.[46] The most common fields of study of second-generation Cuban-Arab migrants at the University of Havana have included law, medicine, pharmaceuticals, and journalism. The Arab migration into Cuba also introduced new goods into the country resulting in the transformation of the living standards and fashion of Cubans. Migrants began to import into Cuba Arab-inspired products, including textiles, photographs, news, music, arts, and cuisine. These have become an integral part of the Arab-Cuban community and culture and the entire Cuban society. As discussed in Section II, this infusion offers validity to ancestry and the formation of ethnic minority communities. It represents the introduction of migrant ancestry as a form of nostalgia and connection to their home country.

The Arab migrant communities soon began to form groups based on cultural heritage. La Union Oriental (1904) and the La Sociedad Suriana were the first two groups to come into existence in Santiago de Cuba. During the period 1928-30, other Arab groups were also established in Havana including La Unión Libanes Siria de Bejucal, la Sociedad Palestina-Árabe de Cuba, and la Sociedad Libanesa de la Habana. These sociedades organized events, published magazines and collaborated throughout the year, but each one of them held very specific ethnic identities within the community. Consequently, there were over a dozen published magazines/literature by these groups. More than 70 percent of Arab migrant communities in Cuba was Christian and a little more than 20 percent being Muslim.

The only institution which integrated both Arab migrants and Cubans was the Masonic Lodge called the Chuada el Arabh (Arab martyrs), which was affiliated with the Gran Oriente Nacional de Egipto/ National Grand Orient of Egypt, when it was first established in Havana in 1932. One of the membership requirements was the ability to speak both Spanish and Arabic.[47]

The Arab community maintained a powerful position as a lobbyist group, which pressured the government, and other sociopolitical Cuban groups for their support for the autonomy of their countries of origin.[48] The *Pan Árabe de Cuba* thus emerged in 1947, specifically for these efforts of solidarity and advocacy for the homelands of the Arab migrants.

---

[45]Menéndez-Paredes, *Los árabes en Cuba*.
[46] Menéndez-Paredes, *Los árabes en Cuba*, 90.
[47] Menéndez-Paredes, *Los árabes en Cuba*, 166.
[48] Menéndez-Paredes, *Los árabes en Cuba*, 177.

This coincided with the time frame of the United Nations' actions regarding the Palestinian and Zionist tensions which resulted in the nationalist action among Arab-Cuban groups and their descendants, regardless of their nationality. This also led to the formation of the Centro Palestino, and the creation of the Comité Panarábigo para la Liberación de Palestina/ Liberation Panarabigo Committee for Palestine in 1947, by Mario Tabraue in the effort to halt the balkanization of Palestine. This is an example of the political and socio-economic power established by the Arab-Cuban community, underscoring the political and economic weight of the Arab population, through elite privileges and also in Cuban politics and government. They supported the numerous examples of anti-Zionist manifestos originating from the Arab-Cuban fundamentalists in prestigious positions of power within Cuban society.[49] This is further evident through the founding of el Comité Nacional Pro Defensa de la Independencia del Libano/the National Committee of Pro Defense for the Independence of Lebanon, in Havana in 1958 and in 1961. They also founded the la Unión de los Libaneses en el Mundo/The Union of the Lebanese in the World (ULM) in direct affiliation with the Lebanese Embassy in Cuba. The main objective of these two groups was to establish ties between the Lebanese migrants in Cuba and their home country in Lebanon, through collaborative efforts in culture, tourism and economics. This was an illustration of a collective sentiment regarding the emotional and psychological ties held by the migrants to their original homeland.[50] In 1979, the unification of all Arab associations in Cuba was achieved by the formation of La Unión Árabe.

Cuban society perceives Arab migrants as "white," in terms of racial classification, as well as a "shrewd" business group. Furthermore, they are regarded as a group that has access to better educational facilities and resources and that holds high positions in Cuban politics. During the field research, the author observed, the amount of cultural capital that the Arab migrants held in the society as doctors, lawyers and businessmen, placed them in a middle class status and eventually into a privileged class status within the society. Arab migrant merchants dealt in such goods as silk, clothing, perfumery, imported knit textiles, silverware, and served as tailors and outfitters, carpenters, and toy and hardware store owners.[51] This socio-economic hierarchy within Cuban society emphasized the historical difference in the perception accorded to the Cuban-Arabs as opposed to the Afro-Cubans brought into the country as slaves. This distinction is important in understanding the discourse on race and ethnic relations in Cuba.

The cultural impact of the descendants of Arab migrants on Cuban society is evidenced in various areas including art, poetry, music and acting. Prominent among such cultural iconic figures include Fayad Jámis, sculptor, painter and poet; Nola Sahig, singer; Kemal Kairuz, pianist; and Raúl Camayd and Baz Tabrane (Taicuba Trio), lyricists; as well as television actors Luis Felipe Bagos, Paula Ali, Felix and Omar, Yamil Jaled and Ibrahim Apud. These individuals are celebrated in Cuban society and culture. They offer meaning to the term Cub*and* or the inclusion of nations that compose Cuban culture through diverse genres of art forms, including visual art.[52]

---

[49]Menéndez-Paredes , *Los árabes en Cuba*.

[50] Michael Humphrey, "Lebanese Identities: Between Cities, Nations, and Trans-Nations," *Arab Studies Quarterly* 26 *(*2004): 31-50.

[51] Menéndez-Paredes, *Los árabes en Cuba*, 77.

[52] Andrea O'Reilly Herrera, *Remembering Cuba: Legacy of a Diaspora* (Austin: University of Texas Press, 2001). First Edition.

Impact of Cuban-Arab Visual Artists

Cuban visual art has been influenced by several external forces, which have helped to shape both the processes and the production of art in the country. These forces have included European avant-garde movements, surrealism, and socio-realism. Additional influences have included the cultural heritage of migrants, slavery, exile, and imperialism. Visual art is comprised of painting, sculpture, photography, multi-media, drawings, installations, and a montage-collage of these artistic representations. Cuban-Arab visual art forms have been historically invisible within Cuban society, though this situation has been changing in recent times. Cuban-Arab cultural impact is seen through religious observance, individual and collaborative art, and in the education sector where reforms demand the inclusion of Islam and Arab influence in Cuban culture.

Contemporary Cuban artists draw on their pluralistic concept of identity to bridge and illustrate the transformative dimensions of art and history. In particular, both art and history must be made from the stories of experience, which includes the artists' interpretation of his/her personal experience as partial and ongoing.[53] Within a global context, contemporary artists work with a complexity of spaces as layered structures that enact processes of translation. For example, spaces consist of interactions between mental and physical domains. Some artists have explored space as organized by identity, hybridity, religion, and psychology by composing autoethnographies.[54] When artists use their personal histories in their works, their *testimonio* is revealed. The intention by the artist is for the observer to recognize the artist's personal experience as narrative.

Despite the myriad obstacles facing Cuban artists in Havana they have successfully organized exhibits, conferences, dance ensembles, and cultural events in the community and national sectors.[55] Cuban artists, Jorge Elías Gil and Francisco Fernández, and Cuban-Arab artist, Lissy Sarraf strive to represent a part of Cuban society that is marginalized.

Cuban and Cuban-Arab artists share a common denominator-- they have a unique connection with Cuba- *a* Cub*and*.[56] The postmodernist world has an enmeshed culture of constant change and transformation. More than physical; it also encompasses psychological spaces of exchange.[57] Moreover, the visual culture of migration that artists produce consists of a fluid and less linear definition. This culture is closely akin to a *radicant*, meaning no single origin, because the artist is simultaneously changing and negotiating.[58] This fluid identity is entangled with the concept that "geography is always also psychogeography"- a connection that expands beyond geographical borders.[59]

Lissy Sarraf: Cuban-Arab Visual Artist

Lissy Sarraf, is of Lebanese descendant and member of La Union Árabe (The Arab Union). She works with various media, primarily, painting and calligraphy. Her Arab-inspired artwork is one of the few Arab representations in Cuban culture but she makes her living through

---

[53] bell hooks, *Art on My Mind Visual Politics* (New York: The New Press, 1995).
[54] D. Smith-Shank and Karen Keifer-Boyd, "Editorial: Autoethnography and Arts-Based Research," *Visual Culture & Gender* 2 (2007): 62-71.
[55] Mario González, *Los árabes* (Havana, Editorial de Ciencias Sociales, 2003).
[56] Andrea O'Reilly Herrera. *Remembering Cuba: Legacy of a Diaspora.* (Austin: University of Texas Press, 2001). First Edition.
[57] Humphrey, "Lebanese Identities."
[58] Nicolaus Bourriaud. *The Radicant*. (New York: Lukas and Sternberg, 2009).
[59] Bourriaud, *The Radicant*, 57.

her artwork without the Arab inspiration. In her work, the ideology of inclusivity into Cuban culture is limited and segregated.

Sarraf is an instructor at the prestigious Instituto Superior de Arte (ISA) in Havana (Institute of Superior Arts), and holds a Master's degree in Education. Her thesis is entitled, *"Educando a través del Arte. Lo Árabe e Islámico en la Cultura Cubana"* (Educating through Art. The Arab and Islamic in Cuban Culture). It is layered with personal story, studio art, and suggestions for curriculum reform in higher education. Sarraf's work, both academic and artistic, is considered a testimonio through autoethnographic. It is not quantitative, scientific, nor linear.[60] It is an expression of creativity. Something lived and felt mingled with oral stories from family members as a form of biomythography.[61]

Sarraf's work encompasses images that are highly intricate in pattern and design using Arabic calligraphy as her structure. The complexities of her paintings and drawings lure the viewer into a reflective state. Her color palate in general is saturated with rich tones of reds, blues and gold, echoing the color palette often found in Middle Eastern cultures. Textiles and geometric use throughout her work are similar to Islamic mosaics and patterns present in Islamic art. The narrative spirit of her work is intrinsic of Islamic culture, as story telling.[62] Her fluid, smooth and endless line work envelopes a sense of movement while her interlacing images and Arabic script throughout space, create a push and pull of light and darkness.

Sarraf's series, *AL Kalimat* is composed of seven paintings. One of these paintings, discussed is the "Untitled" (image #1), an oil on canvas painting with dimensions of 60 x 80 cm. Her work is dense in Arabic calligraphy and script taken from the Quran or phrases that either eludes to religious values or a way of living. In "Untitled", the light blue horizontal brush strokes with gaps of white offer a backdrop to the large calligraphy forms that create a boat shape, carrying calligraphic smaller forms that seem to be holding the oars of the ship, and moving through the sea. The blue-hued color palette eludes water, and fluidness, as if the ship is being carried in spans of ocean.

Sarraf's use of horizontal lines in the background, contrasted with the roundness of the ship's form, offers an environment of tranquil water and reflection. The ship, formed out of calligraphic symbols, carves out a vessel that is enclosed into itself, as if cocooning in safety as it is atop of the water. "Untitled" embodies the vocabulary that Sarraf uses in much of her work, with calligraphy and Quranic verses, as she is nostalgic of her ancestry, their travels to a new country, and a new beginning. Her identity is shaped by the choices of those that have come before, her life largely impacted by the psychological traces of her family's homelands, and the transition into Cuba. She grew up in a home where cultural heritage was present through stories, history, spirituality and profession. This painting illustrates the voyage to new lands, the taking of identity and culture and moving with them.

Jorge Elías Gil: Hybridity, Religion, and Resources

The framework of Jorge Elías Gil as a Cuban scholar and artist is vastly impacted by cultural and religious hybridity and the complexities of gender in Cuban culture. These offer a

[60] hooks, *Art on My Mind.*
[61] Audre Lorde, *Zami: A New Spelling of My Name A Biomythography*. (Freedom: The Crossing Press, 1998).
[62] Titus Burckhardt. *Art of Islam: Language and Meaning*. (London: World Wisdom, 2009).

space of habitation for the physical and the psychological.[63] His Bachelor's Degree in Theology and Master's thesis on Women and Islam add to the complexities of gender roles in Cuban culture and religion within the Arab community in Cuba. Gil's artwork includes drawings, paintings, and sculpture, with a new developing body in collage-montage and short film. His use of a combination of found materials, acrylics, pencil, charcoal, and plaster lend themselves to diversified yet cohesive bodies of works.

Gil's artwork is extensive and spans two decades. The focus on his collage-montage piece, "Templo" (2006, image #2), a mixed medium collage work on canvas, measuring 70 x 60 cm, exemplary of the hybrid creation of his art. Its dark coppered earth tones of background colors offers the illusion of distance, as it lures the viewer into the small square 'window' opening into an illuminated scene of a religious nature.

Gil's framing of the window in *Templo* is accentuated with rusty nails running parallel to the imposed scene depicting *The Old Testament Trinity* painted by fifteenth century Russian iconographer Andre Rublev. These three feminine figures in the painting are situated opposite from a partial framing of thin wood perhaps, insinuating where a trim once stood, as if to try to encase or symbolize the Trinity of God. The title of this piece, "Templo", translates to *Temple*, and the window's image in the bottom-center echoes the subject. The picture plane is highlighted in white and at the right hand bottom corner the capital letters "XPAM" give it weight, as if the three nails are grounding the capital letters which spell out 'temple' in Russian. The sacrificing of the Son of God, Jesus, the temple, through the symbolism of the three nails is magnified. Gil's collage-montage piece holds in conversation the hybridity of religion historically, and the fragmentation of identity through three divine figures that are equivalent to one.

Francisco Fernández: Religion and Resources

Fernandez creates iconic symbols from the Islamic world into works of art that deal with the social and economic conditions conducive to his daily surroundings and life in Cuba. He illustrates his reality of life as a Cuban through the medium he uses in his works of recycled paper components, as mosaic tile pieces. He takes iconic architectural symbols, such as *The Dome of the Rock,* and creates them on cardboard with recycled pieces of cardboard which he salvages, cuts up into tiny little squares of varying tones and colors, and builds his art pieces. He creates masterpieces that range about two feet by two feet, and larger in size with a spectrum of colorful tiles as in mosaic work, often found in Islamic Art. His pieces echo characteristics of Islamic architecture, the intricate patterned tile work. Although Fernández's mosaics often have figural imagery, which are not typical in Islamic Art, they are narrating a story of history, religion, or culture. His mosaic creations, depicting spiritual themes such as *De la colina de Safa a Yathrib* (From the Hill of Safa to Yathrib), *Cúpula de la Roca* (The Dome of the Rock), *La Mezquita de Kodiamín* (The Mosque of Kodiamin), and *El Árabe* (the Arab), offers yet another connection to religion and Arab roots and interweave with the Cuban-Arab ideal, as common with Islamic Art and culture.[64]

Fernández's paper mosaic, "De la colina de Safa a Yathrib," (2012) (image #3), paper and mixed medium is 150 x 160 cm. This intricate and ornate paper mosaic piece, brightly colored palette, and scroll framing of the image resembles an illustrated manuscript page. The composition of four men with their camels and belongings set up against the sky and hills

[63] Behar, Ruth,ed., *Bridges to Cuba= Puentes a Cuba* (Ann Arbor: University of Michigan Print, 1995).

[64]Burckhardt, *Art of Islam.*

situates the setting as on a trail, or a journey. Their journey to the Hill of Safa is referencing the story of when the prophet Muhammad went to the city of Yathrib, now Medina. Fernández, through his mosaic pieces, further discusses the connections of the Islamic Religion, Arab culture and the intricate nature of storytelling, illustration, and daily practice. The jeweled attire, of richly designed garments on the men and the camel perhaps allude to a lucrative position in society, as they travel the road. The layers of scarves and clothes with patterning and threads of brightly colored hues, and head wraps depict the colorful Mediterranean culture and the exchanges of textile and merchandise that allow for these possessions.

Safa was once connected to the mountain of Abu Qubays, while Al-Marwah was connected to the mountain of Qu‘ayqi‘aan. However, during the expansion process in *Al-Masjid Al-Haraam*, As-Safa and Al-Marwah were separated from them and became encompassed inside the mosque after having been outside of it. The distance between As-Safa and Al-Marwah is about 400 m, and in the middle of the Mas‘a [the place where pilgrims perform *Sa`ee* (walking) between As-Safa and Al-Marwah] and the distance is where Haajar, the wife of Prophet Ibraaheem walked in her search for water. Muslim men, and not women, should fast walk this distance. It was reported in Saheeh AL-Bukhaari on the authority of Jaabir, that the Prophet performed Sa’ee between them seven times during his farewell Hajj. The story of Sa’ee between As-Safa and Al-Marwah can be traced back to the time of Ibraaheem serving to commemorate and honor the story of Haajar’s search for water for her child. Allah The Almighty, commanded Prophet Ibraaheem to leave his wife Haajar and their infant son, Ismaa’eel alone in a barren valley, where there were not any water or trees, to test their faith. Ibraaheem obeyed and left his wife and infant with only a few provisions of food and water. Soon after running out of water, the mother was frantic to find water for her son, and so she climbed the nearest hills, Safa and Al-Marwah, she did this seven times with no results. Finally, while she was at Al-Marwah, she looked at her son and saw a spring of water sprouting forth from beneath his feet, thus, the family and valley was revived as Arab tribes settled in it because of its source of water, called ZamZam Well.

This story of hope is but one example of how Islam and expressive art culture meet in a way that offers solidarity of a people, an emotional tie to something larger in an Arab culture that is interfaced with religion, art, traditions, history and story. The Cuban-Arab organizations in Havana are laced with religious themes that Fernández’s artwork illustrates, as a spring of hope, perseverance and solidarity. For example, the Casa Arabe house has a ‘prayer room’ for the Muslim foreign community, and the Islamic League offers religious conferences and observations.

Conclusion

This section discussed the Arab migration into Cuba and its impact on Cuban society. The topics discussed include a history of Cuba, Arab migration into Cuba, categories of Arab migrants, the development of Arab communities, and the impact of Cuban-Arab visual artists. It was discovered that Arab migration into Cuba occurred between the period of the 1860s -1940s, with most of the migrants coming from Lebanon, Syria, Palestine, Turkey and Egypt. The main entry ports were Santiago de Cuba, Cienfuegos and Havana. The migrants were classified as Arab, Turkish, Syrian and Egyptian but the migrant origins were found to be problematic as initially most of them were seen as Syrian due to the geography of the region before it was divided into separate states as a result of European colonization. The study found that Arab migrant communities first developed in Monte, Havana were the migrants quickly became businessmen, doctors, and active members of Cuban society. More importantly, the activities of

the first generation migrants created opportunities for the second generation Cuban-Arabs in the sciences, medicine, law, and politics. They were also found to hold influential political positions in the country. It was also discovered that Cuban-Arab artists have contributed a great deal to the Cuban society. The works of three Cuban artists, Lissy Sarraf, Jorge Elías Gil, and Francisco Fernández, were chosen and analyzed for this study. The three artists shared a common denominator referencing Arab heritage and culture.

The next section presents the summary, conclusions, recommendations, and implications of this research.

Section IV

Summary, Conclusions, and Recommendations

Summary

The purpose of the study was to investigate the impact of Arab migration into Latin America and the Caribbean, specifically into Cuba, from the period 1860-1940s. The methodology for the study employed content analysis of historical documents and books pertaining to the Arab migration into Cuba, the visual arts of contemporary Cuban-Arab artists and data from the author's field research in Cuba from May to August, 2012. The study had two main objectives. First, it discussed the causes underlying the Arab migration and its impact on Cuban society, in terms of race relations, assimilation, socio-economic concerns, and class and identity formation. Second, it analyzed the visual art representations of Cuban-Arab artists, regarding the history and cultural identities of Cuban-Arabs within the Cuban society. The findings of the study confirmed the author's original hypothesis, that the Arab migration into Cuba from the 1860s-1940s, has impacted race relations, created new socio-economic and political hierarchies, and added a new dimension of visual art to the cultural mosaic of Cuban society.

Conclusions

The following conclusions were drawn from the findings of the authors field research work in Havana, visual art analysis and literature review:

1. There is no current single universal definition of migrant

2. Migrants form minority communities in their host society for cultural and group preservation purposes.

3. Migrants use several methods to preserve their cultures, including music, poetry, dance, language and visual art.

4. Cuban-Arabs have impacted the Cuban society in the areas of social, cultural, political, economic, visual art and race relations.

5. Cuban-Arab visual artists have introduced a new dimension of visual art into Cuban society.

Recommendations
Psychological borders and emotional ties to culture and homeland are a significant part of migrant communities and the migration process. Therefore, inclusivity of these varying perspectives and impact on host countries is necessary in order to develop cultural diversity.

1. The definition of migrant needs to be streamlined to include all the various categories of migrants around the globe today.

2. Migrant cultures need to be recognized and included in the host cultures to enable them to feel a part of their new society.

3. The Cuban government needs to encourage Cuban-Arab visual artists in their efforts to add to the cultural diversity of Cuba.

Implications for Further Study
There is a need for further research of Arab migration and its impact on Cuban society and culture, specifically the intersections of class, race and gender and the visual arts.

1. Women and the Visual arts within the Cuban-Arab community.

2. The Arab migration into Santiago de Cuba, and the racialization of this population in comparison to the Arabs who settled in Havana.

3. The Arab-Islamic footprint within Cuban society and the visual arts.

References

Anzaldua, Gloria. *Borderlands/La Frontera: The New Mestiza.* San Francisco: Aunt Lute Books, 1999.

Behar, Ruth. *Bridges to Cuba= Puentes a Cuba.* Ann Arbor: University of Michigan Print, 1995.

Benitez-Rojo, Antonio. *The Repeating Island: The Caribbean and the Postmodern Perspective.* Durham and London: Duke University Press, 1996. Second Edition.

Bernard, Timothy and Bondil, Nathalie. *Cuba: Art and History from 1868 to today*. The University of Michigan: Montreal Museum of Fine Art, 2008.

Bloom, Jonathan and Blair, Sheila. *Islamic Arts*. London: Phaidon Press, 1997.

Boetzkes, Amanda. The Ethics of Earth Art. University of Minnesota Press, 2010.

Bourriaud, Nicolaus. *The Radicant*. New York: Lukas and Sternberg, 2009.

Camnitzer, Luis. *The New Art of Cuba.* Austin: University of Texas Press, 2003.

Castles, Stephen and Miller, Mark J. *The Age of Migration: International Population Movements in the Modern World.* Second Edition. London: MacMillan Press LTD, 1998.

Charon, Euridice. "El Asentamiento de Emigrantes Árabes en Monte (la Habana, Cuba), 1890-1930," *Awraq: Estadios sobre el mundo árabe e islámico contemporáneo*, 1992.

De la Cadena, Marisol. "Reconstructing Race: Racism, Culture and Mestizaje in Latin America." *NACLA Report on the Americas* 34 (2001): 16-23.

De la Fuente, Alejandro. *Race, Inequality, and Politics in twentieth-Century Cuba*. Chapel Hill: University of North Carolina, 2001.

Faist, T et al (eds). International Migration Immobility and Development. New York: Berg Publications, 1997.

Firmat Perez, Gustavo. *Life on the Hyphen: The Cuban-American Way.* Austin: University of Texas Press, 1994.

Garcia Jiménez, Mayda. "La inmigración Arabe en el Caribe en los siglos xix y xx: El Caso de Cuba." *UNESCO & Prodhufi*, 1997.

Grabar, Oleg. *The Formation of Islamic Art*. Connecticut: Yale University Press, 1987.

Gonzalez, Juan. *Harvest of Empire: A History of Latinos in America.* London: Penguin books, 2011.

González, Mario. *Los árabes.* La Habana: Editorial de Ciencias Sociales, 2003.

Hatem, Mervat. "Why and How Should Middle East and African Studies Be Connected?" *International Journal of Middle East Studies* 41(2009): 189-192.

Heisler, B.S. *Migration Theory: Talking Across Disciplines*. New York: Routledge, 2000.

Herrera, Andrea O'Reilly. *Cuban Artists Across the Diaspora: Setting the Tent Against the House.* Austin: University of Texas Press, 2011.

Herrera, Andrea O'Reilly. *Remembering Cuba: Legacy of a Diaspora.* Austin: University of Texas Press, 2001. First Edition.

Hillenbrand, Robert. *Islamic Art and Architecture*. London: Thames and Hudson Ltd, 1999.

Humphrey, Michael. “Lebanese identities: Between Cities, Nations, and Trans-Nations.” *Arab Studies Quarterly* 26 (2004): 31-50.

Humphrey, Stephen R. *Islamic History; A Framework for Inquiry*. Princeton: University Press, 1991.

Hunt, Arthur. “2000 Years of Map Making.” *Geography* 85 (2000): 3-14.

Hooks, bell. *Art on My Mind Visual Politics*. New York: The New Press, 1995.

LaDuke, Betty. *Women and Art in Cuba: “Feminism is Not Our Issue.”* *Woman's Art Journal* 5 (1984 -1985): 34-40.

Lopez, Sebastian. *States of Exchange Artists from Cuba/Estados de Intercambio Artistas de Cuba*. INIVA, 2008.

Lorde, Audre. *Zami: A New Spelling of My Name A Biomythography by Audre Lorde*. California: Persephone Press, 1998.

Massey, Douglas S.; Arango, Joacquin; Hugo, Graeme; Kouaouci, Ali; Pellegrino, Adela; and Taylor, J. *Worlds in Motion: Understanding International Migration at the End of the Millennium.* Oxford: Clarendon Press, 1988.

Massey, Douglas S.; Arango, Joacquin; Hugo, Graeme; Kouaouci, Ali; Pellegrino, Adela; and Taylor, J. “Population and Development Review.” *Population Council* 19 (1993): 431-66.

Massey, Douglas and Taylor, Edward J. *International Migration Prospects and Policies in a Global Market.* London: Oxford University Press, 2004.

Menéndez Paredes, Rigoberto. *Componentes Arabe en la Cultura Cubana.* Ediciones Bolona, 1999.

Menéndez-Paredes, Rigoberto. "Parentesco y Tradicionalidad: Un estudio etnosocial de los inmigrantes árabes de Cuba (1870-1957)." *Miscelánea de estuios árabes y hebraicos. Sección Árabe-Islam 49 (2000).*

Menéndez-Paredes, Rigoberto. “Los Arabes en Cuba.” *Publicaciones de la Oficina del historiador de la cuidad, la Habana,* 2007.

Menéndez-Paredes, Rigoberto. “Los Árabes en América Latina Historia de Una emigración.” Akmir, Abdeluahed (coord.) *Primera Edicion en Castellano* (2009): 365-428.

Moore, Robin. *Nationalizing Blackness: Afrocubanismo and Artistic Revolution in Havana 1920-1940.* Pittsburgh: University of Pittsburgh, 1997.

Ozbay, Muge; Eviner, Inci; Akgun, Tevfik. "Aesthetics Bridging Cultures: Deterritorialization, Performative Identity and Uncanny Representation of Woman's Body in the Works of Ana Mendieta," *Congress of Aesthetics*. Istanbul: Yildiz Technical University, 2007.

Shohat, Habiba Ella. *Talking Vision: Multicultral Feminism in a Transnational Age*. Boston: Massachusettes Institiute of Technology, 1998.

Trouillot, Michel-Rolph. *Silencing the Past: Power and the production of History.* Boston: Beacon Press, 1995.

Wade, Peter. *Ch1* "The Meaning of 'Race' and 'Ethnicity." Race and Ethnicity in Latin America, (1997): 5-24.

Zabel, Darcy A. editor. *Arabs in the Americas, Interdisciplinary Essays on the Arab Diaspora.* New York: Peter Lang Publishing, 2006.

Image #1

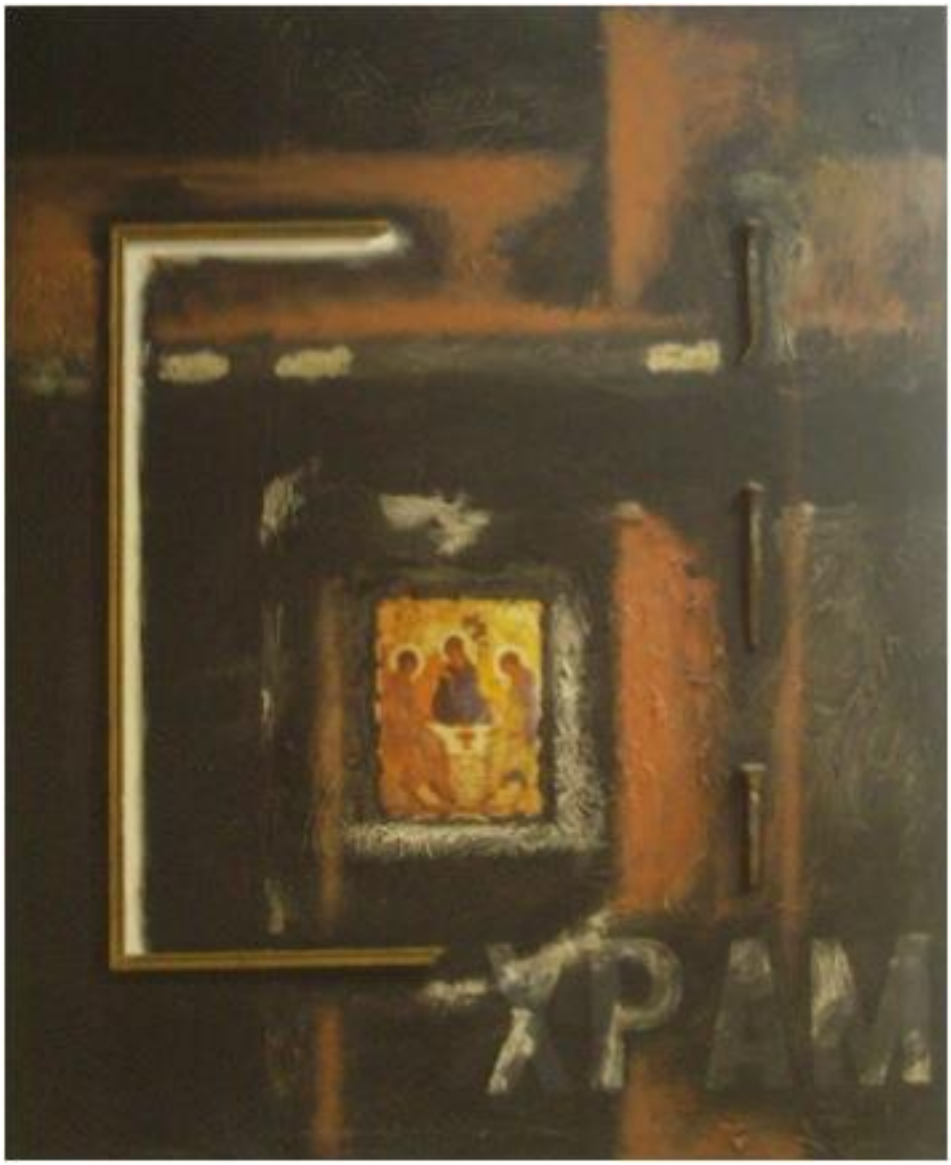


Image #2

Image #3

Communication Problems between Caregivers and Individuals with Dementia: Implications for Caregiver Well-being

Jeanna M. Stiadle, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Adviser:
Dr. Steven H. Zarit, PhD
Distinguished Professor and Head of Human Development and Family Studies
College of Health and Human Development
The Pennsylvania State University
Adjunct Professor
Gerontology Institute
University College of Health Science, Jönköping, Sweden

Abstract

Communication problems resulting from dementia have been extensively described by clinicians, but little research has examined how these problems affect family caregivers. As individuals with dementia (IWDs) experience decreasing communication capacity, caregivers may develop feelings of burden. This study investigates different aspects of communication behaviors and their effects on caregiver outcomes using cross-sectional and longitudinal analyses. I identified scales for positive, aggressive, and depressive communication to test them as predictors, and related them to caregiver outcomes: depression, anger, positive affect, and role overload. This research will pave the way for interventions to improve communication between IWDs and caregivers.

Introduction

A woman named Valerie describes her most frightening encounters with her husband, Donald, as he struggles to communicate in the face of his severe dementia. In the following quote, she expresses that the communication disorder sometimes provides a catalyst for violence. "He's attacked me three or four times. At first I thought he was trying to kill me, but he's expressing his anger…There's times I've wanted to hit him" (Aneshensel, 1995, p. 116). Researchers project that by 2050, there will be over 65 million cases of dementia worldwide (Katzman and Fox, 1999). While affected individuals themselves command a great deal of attention, research often neglects the syndrome's severe impact on family caregivers of individuals with dementia.

Caregivers experience a multitude of problems regarding their relationships with Individuals With Dementia (IWDs) (Zarit, 1985). IWDs are typically older adults, who face physical limitations that create communication difficulties, which may include: loss of hearing, decreased visual acuity, and increased reaction and processing time (Nussbaum, 2000). Individuals with a compromised ability to communicate, such as IWDs, may be less likely to receive help with communication that pertains to goals outside of simple wants and needs (Light, 1997; Blackstone, 1996) For older adults, this issue is particularly problematic, since their isolation inhibits their valued communication needs. In particular, this specific population requires both social closeness(communicating to develop and maintain social relationships) and

information transfer(sharing information with communication partners), but may experience difficulty achieving such needs, further alienating the group from others (Blackstone, 1996).

As a response to the frustration and stress associated with the inability to communicate effectively, an IWD may exhibit aggressive and/or depressive communicative behaviors. These problems typically upset family caregivers because they represent changes in the relationship with the IWD. Furthermore, additional issues such as caregiver burden, role overload, and depression may contribute to communication problems with the IWD (Germain, 2009). Since interactions between IWDs and caregivers are so strenuous, they likely affect caregiver well-being in a severely negative way.

Although many studies acknowledge communication struggles between IWDs and caregivers, few examine the emotional nature of these problems. This study analyzes the various types of communication behaviors exhibited by IWDs and the corresponding effects on caregiver burden and well-being. This project will benefit researchers because it proposes new, more dyad-focused communication intervention strategies for *both* the demographic of IWD's, as well as their caregivers. Such interventions will help caregiver care-receiver dyads, such as Donald and Valerie, to communicate more effectively and salvage their relationship in the midst of dementia's grasp.

Communication Issues for Older Adults

Several physical problems associated with aging create communication difficulties for the majority of older people. In particular, sensation and perception play a primary role in communication capacity and ability. For example, visual acuity decreases with age, making non-verbal cues more difficult to perceive. This alteration has numerous consequences. First, context cues gradually disappear from conversation. In addition, gestures and subtle facial expressions become extremely hard to recognize. Meanwhile, progressive hearing loss and diminishing sense of touch continue to affect sensation and perception. The former affects an older adult's ability to comprehend spoken language, and the latter hinders an individual's ability to perceive feelings of warmth and social closeness. Other neurological changes lead to increased processing time and reaction time during conversation (Nussbaum, 2000).

The aforementioned changes in sensory ability tend to cause such persons to feel stigmatized by others. When these issues combine, they result in an increased amount of anxiety and decreased confidence for elderly people during conversation (Nussbaum, 2000). As a result, an affected individual may avoid conversation altogether rather than face the anxiety associated with constantly asking communication partners to repeat themselves. Alternatively, individuals may demonstrate compensating behaviors, such as filling in the "blank" for unheard words to maintain conversations, leading to further struggles with comprehension. The combination of these phenomena results in an overall longer duration of conversation and higher frequency of communication breakdown which may be exceeding frustrating to participants (Buller, 2005).

Communication and Dementia

The onset of dementia only intensifies the previously mentioned communication issues for the elderly. Numerous researchers and clinicians have documented communication disorders related to dementia and noted the escalation of their effects over time. In the early stages of

dementia, individuals may demonstrate a lack of certain semantic skills. For example, individuals might have difficulty trying to generate as many words as possible within a category (Lubinski, 1995). In this primary stage, the ability to comprehend abstract language may also begin to suffer. Although individuals can still easily participate in social conversation, they may struggle to comprehend complex syntax in speech. By the moderate stages of dementia, adults experience difficulty remaining on topic, using pronouns correctly, and retrieving words during conversation. In addition, affected individuals might struggle to understand directions in sequence (Buller, 2005). Eventually the progression leads to the onset of paraphasia, making spoken language extremely hard to interpret. At this advanced stage, individuals can no longer participate in social interactions through communication due to their extreme impairments (Lubinski, 1995). Thus, the countless changes in language ability over time vastly affect the individual's ability to communicate.

Effects of Communication Difficulties

The communication difficulties discussed in the previous section affect several distinct aspects of the lives of IWDs. To illustrate these effects, Banerjee et al (2010) investigated several factors related to quality of life for individuals with dementia. He pinpointed successful communication as one of the most important mechanisms related to good quality of life for these individuals.

Several explanations may account for these results. When unable to express wants and needs through spoken language, individuals with dementia lose the ability to control their care. At the same time, IWDs might begin to lose necessary receptive skills, making it harder for caregivers to explain procedures during care. These dual losses inevitably lead to further confusion for IWDs and may contribute to diminishing feelings of dignity (Nussbaum, 2000). In addition, Banerjee et al (2010) argued power of choice as necessary for maintaining an adequate quality of life. Without adequate ability to communicate, the IWD cannot exercise control over his life to decide important choices such as what to eat for breakfast or whether or not to sell his home. All in all, studies have concluded that IWDs who have difficulty with communication likely experience a compromised quality of life as a result of these several contributing factors.

Other possible effects of communication loss include aggressive and depressive behaviors, such as those demonstrated by Donald in the introductory vignette. Notably, the Revised Memory and Behavior Checklist, a survey used for caregivers to document observable behavioral patterns associated with dementia, identified several depressive and aggressive behaviors commonly reported by caregivers of IWDs. Aggressive behaviors, such as arguing, verbal aggression, and dangerous threats or actions, and depressive behaviors, such as crying, comments about loneliness, and comments about death, name just a few of the numerous problem behaviors associated with dementia (Teri et al, 1992). These challenging behaviors indicate stress and frustration from the IWD and have a universally negative impact on family caregivers (Robinson, Adkisson, and Weinrich, 2001). Likewise, these reported problem behaviors may contribute to IWD's inability to communicate effectively in other ways.

Similarly, Richter (1995) examined the direct experiences of family members communicating with IWDs. The participants involved in his study reported that loved ones exhibited feelings of anger and agitation, as well as suspicion and wandering behavior. In response, caregivers felt that they needed to communicate with IWDs to reduce the behavior and

provide adequate comfort, and in return they experienced angry and agitated communication from their loved ones. Furthermore, some individuals reported that they felt as though they had lost their loved ones to the disease (Richter, 1995). In essence, the study confirmed that the loss of ability to communicate leads to increased behavior problems among IWDs. Therefore, caregivers must adapt the environment and communication strategies used to prevent as many behavior problems as possible.

The preceding studies provide a background for future research to explore the specific effects of communication disorders on IWDs. More research will determine the particular communication challenges that have the biggest impacts on these individuals. In addition, future research should clarify the motives of problem behaviors and their possible relationships to communication discrepancies. The psychological health and communication problems of IWDs could be measured longitudinally to document changes related to the disease's progression. Future studies could use this information to measure the impact of communication disorders on the psychological health of IWDs.

Caregiver Burden and Well-Being

Despite the independent effects of dementia on IWDs alone, communication difficulties affect both members of an interactional dyad. An extensive amount of research on the concept of caregiver burden describes the extreme psychological effects related to informal caregiving. To clarify, Zarit (1985) describes caregiver burden as "the extent to which caregivers perceive their emotional or physical health, social life, and financial status as suffering as a result of caring for their relative" (p. 23). Communication struggles between IWDs and caregivers, due to the IWD's changes in personality and failing cognition, as well as limited social support for the dyad may contribute to the intensity these feelings of burden and lead to an eventual burn-out in some caregivers.

To illustrate this relationship, studies have investigated depression and anxiety in caregivers as a result of the significant changes in the personalities of IWDs (Gallagher, 1989). Pasporouvov et al (2007) found that aggressive and threatening behavior demonstrated by the individual with dementia seemed to be positively related to caregiver burden. IWDs may act out with these inappropriate behaviors as a result of anger and resentment. In response, caregivers must manage these difficult behavior problems and work tirelessly to resolve them (Lubinski, 1995). Often, caregivers feel completely isolated when dealing with this burden, lending to further psychological struggle.

Further, since IWDs struggle with communication problems, they cannot provide understanding or comfort to their caregivers, undoubtedly increasing the amount of perceived burden. As an illustration, Savundranayagam et al (2005) investigated the influence of communication difficulties between caregivers and IWDs on caregiver burden. Communication problems were assessed using a sixteen-item inventory, and caregivers identified which issues affected their relationships. The scale included items that targeted both semantic and pragmatic language difficulties. One item, for example, addressed whether the IWD paused often during conversation. Another item considered whether the IWD tended to repeat questions over and over again. Results showed increases in stress for both the caregiver and IWD, indicating that the presence of language problems did increase caregiver burden. In addition to communication, other known stressors that contribute to caregiver burden, such as financial difficulties, continue

to mount as the disease progresses with the addition of extra care (Savundranayagam et al, 2005). Altogether, the combination of these stressors over time leads to an incredible amount of caregiver burden.

Unfortunately, high feelings of caregiver burden can lead to an eventual "burnout" in caregivers. (Zarit, 1985). According to Alden (2003), caregiver burnout can result in health problems and corresponding behaviors associated with stress. Physical symptoms of burnout include high blood pressure, stomach pain, and headaches. Further, attitudes and behaviors that indicate caregiver burnout include insomnia, short-temperedness, crying spells, and neglect of the care-receiver. For the health and safety of both the caregiver and IWD, at-risk individuals must address stress before it progresses to burnout (Milićević-Kalašić, 2009).

Alternatively, multiple studies have focused on the negative effects of caregiving on mental health and well-being respectively. Most of these studies have reported that caregivers of IWDs have an increased risk for both depressive symptoms and anxiety (Lubinski, 1995). In fact, Zarit et al. (1985) declared caregivers as "hidden victims of Alzheimer's disease." Caregivers regularly report anxiety and depression as a result of stress. A variety of sources—including memory and behavior problems—lead to the eventual stress experienced by the individual with dementia. Accordingly, in order to adequately assess the changes in caregiver well-being, researchers must consider these several factors.

Numerous researchers have already taken the step to consider causes of stress and depression in caregivers. For instance, Covinsky et al (2003) conducted a study to examine the causes of depression in caregivers. They found that high dementia severity, low caregiver income, and decreased function in IWDs positively correlated with caregiver depression, suggesting that these issues are risk factors for caregivers. However, Covinsky et al (2003) did not examine communication problems directly. Fortuitously, Rabins and colleagues (1982) conducted a study that measured communication disorders as risks for stress. Although this particular study did not specify the communication disorders prevalent among participants, it suggested that these difficulties prevented the dyad to from exchanging information. They found that seventy-five percent of caregivers who dealt with communication difficulties as a result of dementia considered these issues "caregiving problems" (Rabins et al., 1982). Altogether, these studies reinforce the consideration of communication problems as both stressful and damaging to the caregiver-care receiver relationship.

Other research has considered the direct impact of memory and communication problems on close family members of IWDs. For example, a phenomenon called disconfirmation may occur between younger individuals and IWDs as a result of memory loss. Specifically, individuals with dementia might forget conversations and, eventually, even the faces of their loved ones. This development often devastates family members and makes communication less and less fulfilling for both parties (Nussbaum, 2000). A study by Orange (1991) details family perspectives on communication changes. Incidentally, he found that family members could describe the negative shifts in pragmatic and discourse functioning in IWDs. In addition, relatives spoke about the impact of the communication problems on their relationships specifically. In particular, they discussed feelings of frustration, loneliness and social isolation associated with caring for someone who had significant trouble with communication (Orange, 1991). To conclude, this research indicates that family caregivers are indeed aware of the

personality and communication changes in IWDs as well as the emotional impact associated with changes.

Similarly, a related study by Germain et al. (2009) investigated the specific influence of cognitive difficulties on caregiver well-being. Some of the language skills assessed during the study included ability to name object and carry out three step commands. Overall, this study found that cognitive difficulties, particularly surrounding language impairments, intensify caregiver burden. This finding indicates that deficits in language ability likely contribute to strain in the relationship between the caregiver and care receiver. However, results also suggested that caregivers who are more involved in social networks and have ample support from loved ones tend to report decreased feelings of caregiver burden (Germain et al, 2009). Even more, this conclusion suggests that caregivers might "make-up" the loss of social interaction with their loved ones by maintaining other avenues of social support.

The stress associated with caregiver burden seriously impacts affected individuals. Therefore, future research should determine the factors that lead to this phenomenon. Although, current research has indicated that communication struggles do occur between IWDs and their caregivers, but little has examined the clinical nature of these problems. More research should measure the effects of communication difficulties on caregiver burden and well-being to pinpoint the exact contributions of each type of problem. Above all, future studies should provide detailed explanations of the particular communication difficulties experienced by each IWD to determine the best form of intervention for the caregiver/care-receiver dyad.

Intervention

In response to the various communication problems identified, the literature has reported several intervention strategies to promote successful communication. These strategies can maintain and, in some cases, improve the quality of communication between caregivers and IWDs, thereby enhancing the social experiences for both parties (Lubinski, 1995). Such techniques make communication management possible for these individuals (Haberstroh, 2011).

Several proposed interventions focus on helping IWDs to improve communication without much consideration for the caregiver. For instance, group therapy with IWDs has been shown to improve receptive and expressive language. Another intervention might include teaching the individual some new adaptive coping strategies to help promote successful communication, such as encouraging the IWD to ask the communication partner to repeat or modify messages for comprehension (Rau, 1993). In addition, cuing strategies may help IWDs with word-retrieval problems in particular. This form of therapy encourages IWDs to use a semantically related phrase in place of the intended word in hope of eventual retrieval. Moreover, therapists might encourage using sequencing techniques or life experiences when explaining stories and abstract ideas to avoid communication breakdowns (Lubinski, 1995). Memory books as a form of augmentative and alternative communication have increased the number of informative utterances demonstrated by IWDs in nursing homes (Bourgeois et al, 2001). Furthermore, these strategies can indeed lend to improvement in expressive and receptive language abilities for IWD.

Other therapies focus on the caregiver rather than the IWD alone. For example, the caregiver should increase opportunities for conversation and allow IWDs more control during

interactions. Caregivers can also learn to enhance verbal interactions with IWDs by modifying syntactic and lexical components of their speech (Small et al., 2003; Rau, 1993). To illustrate, Small et al (2003) discovered that when caregivers simplified sentences, fewer breakdowns occurred between the dyad. Nonetheless, interventions that incorporate forms of intervention for both the caregiver and care-receiver rather than just the caregivers alone, such as through the use of memory aids and caregiver training, yield successful results in increasing and enhancing communicative interactions (Egan et al, 2010).

Caregivers can implement communication strategies even in the face of a behavioral outburst. Aggarwal et al (2003) found that as a result of being unable to communicate, IWDs became more depressed or aggressive. However, through the implementation of communication strategies, such as asking more broad and open-ended questions to elicit more information during conversation, and implementing person-centered care, interactions between caregivers and care receivers will improve to enhance social competence and independence for the individuals with dementia (Aggarwal et al, 2003).

As has been noted, several of the current interventions to improve communication focus on either the IWD or caregiver alone to improve communicative behaviors. Most strategies for caregivers focus on expressive rather than receptive communication (Rau, 1993). That is, clinicians should give more clear instruction as to how to improve the caregiver's speaking skills to accommodate individuals with dementia, but seldom teach strategies for understanding the communication of IWDs. Further research will clarify the need for strategies targeting both members of the communication dyad. Interventions focused around this dyadic relationship could improve outcomes for the caregiver and care-receiver

Summary & Implications

Current research has documented several changes in communication as a result of aging. Consequently, when individuals who already face these changes begin to experience the effects of dementia, communication becomes even more difficult. Unfortunately, each progressive stage of the syndrome marks the development of additional communication problems for affected individuals (Lubinski, 1995). The inability to communicate effectively has debilitating effects on individuals with dementia, as they lose the ability to control decision making and care routines (Banerjee et al, 2010). Just as the individuals themselves are negatively affected, dementia impacts the lives of caregivers, too. In some cases, caregivers report feelings of burden (Zarit, 1985) and burnout (Alden, 2003). Communication difficulties between caregivers and IWDs may relate to these consequences (Savundranayagam, 2005). Interventions to increase communication between IWDs and caregivers have been effective for more frequent, quality interactions with caregivers (Rau, 1993).

Despite the extensive research available on communication disorders and dementia, very little has examined the exact psychological effects on the IWD and caregiver as a result of such challenges. Likewise, very little literature details the impact of communication disorders associated with dementia on caregiver burden and well-being. Another issue with the current research on dementia and communication problems concerns the methods that studies employ. More researchers should consider the methods of Aggarwal et al (2003) and adopt longitudinal measures to examine the changes in communication of IWDs throughout the progression of the disease. Because each stage involves different types of language and communication problems,

researchers should consider different intervention strategies depending on each particular stage. Future studies should also consider larger sample sizes of caregivers and IWDs to encompass a wider range of cultural and socioeconomic backgrounds. The study conducted by Savundranayagam et al (2005) found compelling evidence regarding the effects of communication problems on caregiver burden. However, the study only included eighty-nine participants—not generalizable to the entire population of caregivers. Therefore, past studies have indicated several implications for alternative methods of future studies.

Further research will pave the way for new interventions to increase communication between caregivers and care-receivers. With the help of this necessary research, clinicians will employ more dyad-focused interventions and, thereby, lessen caregiver stress. Successful intervention strategies will lead to increased quality of life for both the IWD and the caregiver, yielding more positive outcomes for all who cope with this devastating syndrome.

Current Study

Purpose

To determine whether certain types of communication patterns are related to specific caregiver outcomes

Hypotheses

1. Positive communication exhibited by the IWD will have a positive association with a caregiver's positive affect and a negative association with caregiver anger, depression, and role overload.

2. Depressive communication exhibited by the IWD will have a negative association with a caregiver's positive affect and a positive association with caregiver anger, depression, and role overload.

3. Aggressive communication exhibited by the IWD will have a negative association with a caregiver's positive affect and a positive association with caregiver anger, depression, and role overload.

4. Increases in a caregiver's anger, depression, and role overload over time will be associated with increasing aggressive and depressive communication and decreasing positive communication. Decreases in a caregiver's anger, depression and role overload over time will be associated with decreasing aggressive and depressive communication and increasing positive communication exhibited by the IWD.

5. Increases in a caregiver's positive affect over time will be associated with increasing positive communication and decreasing aggressive and depressive communication exhibited by the IWD. Decreases in a caregiver's positive affect over time will be associated with decreasing positive communication and increasing aggressive and depressive communication exhibited by the IWD.

Design and Methods

Participants

The present study is part of the Family Caregiving and Respite Evaluation Study (Family CARES). The Family CARES study investigated the effects of adult day services (ADS) on caregiver stress. The sample consisted of 214 dyads of IWDs and their family caregivers. Participants included individuals enrolling a relative in ADS recruited by staff from various ADS programs. In addition, the research team recruited a control group comprised of participants who did not take advantage of ADS. Researchers recruited these individuals through various community resources, such as the Alzheimer's Association and local in-home respite programs. In order to qualify for participation in the study, individuals had to have a valid dementia diagnosis and live in the same household as the informal (family) caregiver. The majority of participants resided in New Jersey, although the study also included one county from Pennsylvania.

The current study utilized baseline data (collected before ADS began), second wave data (collected three months after beginning ADS), third wave data (collected six months after beginning ADS), and fifth wave data (collected one year after beginning ADS). The fourth wave data (collected 9 months after beginning ADS) was used to gather information about health utilization and did not include the communication or behavior items. Thus, the fourth wave of data was not analyzed as part of the study.

The average age of the caregivers in the study was 62.79 years. There were more female caregivers (79.5%) than male caregivers involved in this study. In addition, forty-six percent of the sample included spouses of IWDs, while the latter fifty-four percent consisted of sons, daughters, son/daughter in-laws, and others. Table 1 presents the precise demographic information.

Table 1 Demographic Information

	M	*SD*	Range
Treatment Group (ADS=1)	1.37	0.49	0-1
CG's characteristics			
Age	62.79	12.74	37-87
Education Level	13.51	2.24	0-17
Income	4.79	2.91	1-11
Duration of care (months)	33.47	31.50	1-192
Female (yes=1, no=0)	0.79	0.41	0-1
Spouse (yes=1, other=2)	1.54	0.50	1-2
White (yes=1, no=2)	1.14	0.34	1-2
Married (yes=1, no=2)	1.26	0.44	1-2
Employed (yes=1, no=0)	0.32	0.47	0-1
IWD's characteristics			
Age	80.08	8.12	51-101
Female (yes=1, no=0)	0.57	0.50	0-1
ADL impairment(0-39)	24.36	8.31	0-39

Note: CG=Caregiver, ADL=Activities of Daily Living, IWD=Individual with Dementia
Caregiver education ranged from no school (0) to post-graduate level (17)

Caregiver Income ranged from less than $10,000 (1) to $100,000 and over (11)

Procedures

All procedures in the Family CARES study were previously approved by the Penn State University Institutional Review Board (IRB). Trained research assistants interviewed caregivers in their households. During these 90-minute, face-to-face interviews, caregivers disclosed information about themselves and the IWD. Researchers only assessed IWDs to determine cognitive status through the Mini-Mental State Exam (MMSE) (Folstein, Folstein & McHugh, 1975). Caregivers provided information for all other measures of the study.

Using the Weekly Record of Behavior (WRB), caregivers reported frequency of behaviors demonstrated by the IWDs as well as the resulting stress (Son et al, 2007). Prior work with the WRB suggests that the measure has both high stability and reliability (Fauth et al, 2006). The WRB assessed the frequency of fifty-three behaviors demonstrated by IWDs. Caregivers were asked whether the behavior had occurred in the past week, how often it occurred, and how stressful it was. The present study focused primarily on behaviors surrounding aggressive, depressive, and positive communication. A set of twenty-nine items from the WRB addressed communication between the caregiver and care receiver. A factor analysis with varimax rotation using principal components extraction yielded three factors from these twenty-nine items. Sixteen items did not load on any factor and were dropped from the analysis. The three factors consisted of aggressive, depressive, and positive communication items respectively. All three factors produced Eigenvalues over 1.4. The aggressive communication items had factor loadings ranging from 0.44 to 0.77, positive communication items had loadings from 0.69 to 0.82, and depressive communication items had loadings from 0.55 to 0.74. Table 2 presents the exact values produced by the factor analysis.

Table 2 Factor Analysis: Rotated Component Matrix

	Depressive	**Positive**	**Aggressive**
# of times relative expressed feeling sad or hopeless	0.72	0.14	0.06
# of times relative cried and was tearful	0.55	-0.01	0.26
# of times relative commented on death of self or	0.74	-0.02	0.05
# of times relative talked about feeling lonely	0.64	0.12	0.10
# of times relative mentioned worthlessness, failure,	0.69	0.05	-0.13
# of times relative took part - showed interest in	0.03	0.69	-0.03
# of times relative took part - showed interest in	0.02	0.79	0.16
# of times relative talked about something with	0.06	0.82	0.02
# of times relative showed enjoyment or appreciation	0.08	0.70	-0.13
# of times relative argued, complained, or was	0.51	-0.11	0.52
# of times relative was verbally aggressive	0.12	0.03	0.72
# of times relative displayed jealousy	0.39	-0.05	0.44
# of times relative threatened to hurt others	-0.10	0.05	0.77

Notes: Extraction Method: Principal Component Analysis.

Communication Scales

Using the factors yielded during analysis, I constructed scales to determine three different styles of verbal communication: positive, depressive, and aggressive. Although the WRB did not specifically target communication disorders, I chose to look at aggressive and depressive communication items, as these behaviors may indicate a lack of ability to communicate effectively. In addition, I elected to examine behaviors indicating more positive communication to represent successful communication elicited by IWDs. The positive communication measure contained four items. Specifically, positive communication occurred when the IWD voluntarily participated in activities, took part or showed interested in conversations, talked about something with the caregiver, or showed enjoyment or appreciation. The aggressive communication measure included four items as well. To illustrate, aggressive communication occurred when the IWD argued or complained, was verbally aggressive, displayed jealousy, or threatened to hurt others. Finally, the depressive communication scale contained five items. Examples of items included times when the IWD expressed feelings of sadness and hopelessness, cried or was tearful, commented about death of self or others, talked about feeling lonely, or mentioned worthlessness, failure or being a burden. For all three of the communication measures, caregivers reported whether or not each behavior occurred and the number of times each behavior occurred in the past week. For the depressive and aggressive communication items, caregivers also reported how stressful the behavior was on a scale ranging from 1 (indicating "not at all") to 5 (indicating "very stressful").

I constructed the three previously mentioned scales by summing the number of times each particular communication behavior occurred, respectively. To measure the stress associated with the aggressive and depressive communication dimensions, I created additional weighted scales. To construct these stress appraisal scores, I multiplied the number of times each behavior occurred by the corresponding stress level and summed the results.

Outcomes

Caregiver outcomes included measures of depression, anger, positive affect, and role overload. I selected these particular measures to document the negative as well as the positive consequences associated with the various forms of communication experienced by caregivers. In other words, I reasoned that depression and overload might be related to depressive communication, anger to aggressive communication, and positive affect to positive communication.

To assess the frequency of caregiver depression, I used the CES-D depression scale (Radloff, 1977). This standard scale measures twenty different items to document the number and intensity of depressive symptoms that have occurred over the past week. One example of an item from this scale addressed whether caregivers felt lonely. To respond, caregivers indicated the frequency of each symptom by choosing a response ranging from "rarely or never" (0) to "most of the time" (3). I combined the twenty items to form a summary score, with higher scores indicating increased depressive symptoms.

Similarly, overload, which refers to the feelings of exhaustion and burnout experienced by caregivers, was assessed using a 6-item scale (Pearlin et al., 1990; Zarit et al, 1998). Using the provided instructions, caregivers reported how often they experienced various feelings associated with overload (Kim et al, 2012). Some examples of questions from this scale include, "How often do you have time for yourself," and "How often do you feel you are able to relax?" Participants answered from a response sheet listing choices from "none of the time"(0) to "all of the time" (3). A summary score was calculated from these responses with a higher score designating more feelings of overload. I measured caregiver anger using a scale consisting of four items. Specifically, these items assessed how often a caregiver felt critical of others or became angry easily. Participants indicated responses to these questions ranging from, "not at all" (0) to "very much" (3) (Derogatis et al, 1973; Pearlin, et al, 1990). Once again, I combined these responses to form a summary score; low score results indicated a lower amount of anger, while higher scores demonstrated increased caregiver anger.

Finally, the positive affect scale was constructed from a 10-item scale that assessed the frequency of caregivers' positive emotions throughout the day (PANAS; Watson et al., 1988). One question from the positive affect scale asked how often caregivers felt enthusiastic. In response, participants chose answers ranging from, "not at all" (0) to "extremely" (4). In a similar manner to the previous scales, I combined the responses to form a summary scale where a higher score indicated more positive affect, and a lower score indicated less positive affect.

Covariates

To control for other possible factors related to the outcome measures, I included demographic information as predictors. These specified control variables included the caregiver's education level and the kin relationship between the caregiver and IWD, and the IWD's ability to perform activities of daily living (ADLs). Caregiver education level was measured by how many years of education the caregiver had received. Using these answer choices, participants indicated whether they had completed elementary school, high school, college, or graduate school. I evaluated the kin relationship variable by asking caregivers whether they were spouses of the IWD. If the caregiver was not a spouse of the IWD, I identified him/her as "other." Finally, I measured the IWD's ability to perform ADLs using a scale of thirteen items. These specific items measured whether or not the individual was able to perform daily tasks such as housework, shopping, and answering the telephone (IADL; Lawton, 1971) and personal activities such as eating, dressing, and bathing (PADL; Katz, et al., 1963).

Study 1: Cross-Sectional Analysis

For the first study, data was analyzed using version 20 of the SPSS statistical software. I performed multiple linear regressions to assess the main hypotheses and determine the outcomes related to each form of communication. In the regression models 1 to 4, caregiver depression, positive emotions, caregiver anger, and caregiver overload were the outcome variables, respectively For each of the four models, independent variables were entered simultaneously: control variables (kin relationship between caregiver and IWD, caregiver education, and ability to perform activities of daily living), aggressive communication, positive communication, and depressive communication. This model served to determine the amount of depression, anger, overload and positive emotions associated with each form of communication.

Study 2: Longitudinal Analysis

For the second study, I performed growth curve modeling (also known as multilevel or random coefficient modeling) using longitudinal data with four waves from the Family Cares Study. The data was analyzed using version 9.3 of SAS statistical software, and I used SAS PROC MIXED procedure (Littell, et al 1996) to examine the main effects of the predictors on caregiver depression, overload, positive affect, and anger over time. Such multilevel models include both a level-1submodel to describe intra-individual change, as well as a second level model that demonstrates between-person differences in longitudinal change (Singer & Willett, 2003). Each of the multi-level models was based on measurements collected at the baseline, second, third, and fifth waves of the study.

Three of the models tested the previously mentioned negative caregiver outcomes (caregiver depression, anger, and overload) and one tested positive affect. For all four of the models, I examined the main effects of time (baseline through wave five), and communication dimensions (aggressive, depressive, and positive), controlling for other covariates that are known to affect caregivers' longitudinal affective well-being (IWD's ability to perform ADLs, caregiver education, and kin relationship).

I performed the growth curve analysis in two blocks. For the first block, I was primarily interested in discovering whether or not there was a longitudinal effect for each outcome. For each of the four models, I tested linear, quadratic, and cubic effects of time. Concerning Models one and two (Depression and Anger), I did not find the time effect significant, prompting the removal of this predictor. For these two models, I proceeded with a second set of analyses to examine the within-person and between-person affective trajectories and covariation for both outcomes without the time predictor.

In contrast, the linear time effect did show significance for models three and four (Overload and Positive Affect). Thus, for these two models, I performed the second set of analysis including the time effect to further analyze the within-person and between-person trajectories of the outcomes. The growth curve model (levels 1 and 2) appears below. Each caregiver (*i*)'s, individual outcome (depression, anger, positive affect, overload) at time *t*, y_{it}, is a function of β_{i0} (the within-person intercept at baseline), β_{i1} (the within-person slope of depressive communication), β_{i2} (the within-person slope of aggressive communication), β_{i3} (within-person slope of positive communication), β_{i4} (the individual-specific IWD ADL ability level), and e_{it} (the individual-specific residual error). Since the time effect was significant in the caregiver overload and positive affect models, a fifth parameter to represent linear time, β_{i5}, was added to the function. The βs were then defined in the Level 2, between-person, equations. β_{i0} was specified as a function of an intercept (γ_{00}, the grand mean of affect), caregiver education level (γ_{10}, when kin relationship is non-spouse,), and whether caregiver is spouse (γ_{20}, when caregiver has no formal education) as well the between-person random effect (μ_{i0}, between-person differences in within-person intercept).

Level 1 Equation (Within-Person):

$$y_{it} = \beta_{i0} + \beta_{i1}\,(depressive\ communication_{it}) + \beta_{i2}(aggressive\ communication_{it}) + \beta_{i3}(positive\ communication_{it}) + \beta_{i4}(ADL\ Total_{it}) + [\beta_{i5}(Time_{it}(only\ included\ for\ positive\ affect\ and\ caregiver\ overload, Models\ 3\ and\ 4)] + \varepsilon_{it}$$

Level 2 Equations (Between-Person):

$\beta_{i0} = \gamma_{00} + \gamma_{10}(caregiver\ education_i) + \gamma_{20}(spouse_i) + \mu_{i0}$

$\beta_{i1} = \gamma_{01}$

$\beta_{i2} = \gamma_{02}$

$\beta_{i3} = \gamma_{03}$

$\beta_{i4} = \gamma_{04}$

[$\beta_{i5} = \gamma_{05}$(only included for positive affect and caregiver overload outcomes in Models 3 and 4)]

Results

Study 1: Cross-Sectional Analysis

I performed linear regressions to examine associations between the four measures of caregiver outcomes (depression, anger, overload, and positive affect) and the three communication patterns. In addition, I controlled for the caregiver's level of education, relationship to IWD (spouse or non-spouse), and the IWD's ability to perform activities of daily living as control variables. All four of the models produced significant "F" values, indicating that the regression models fit the data well. I will examine each dependent measure and its associations as determined by the regression analyses.

Caregiver depression as an outcome showed a significant, positive relationship with aggressive (β= 0.157, p< 0.05) and depressive (β= 0.172, p< 0.05) communication as predictors. Positive communication (β= -0.195, p< 0.01) had a significant negative association with caregiver depression. However, none of the covariates had significant associations with caregiver depression.

Depressive communication also had a significant, positive relationship with caregiver anger (β= 0.271, p< 0.001), whereas positive communication had a significant, negative association with caregiver anger ((β= -0.311, p< 0.001). Two of the covariates also had significant associations with caregiver anger. The IWD's ability to perform ADLs had a negative relationship with caregiver anger; the more dependent the IWD was on the caregiver, the higher the caregiver's anger score. Kin relationship had a positive relationship with caregiver anger, indicating that caregivers who were not spouses tended to report more anger.

The third outcome variable, caregiver overload, had a significant positive association with aggressive communication (β= 0.186, p< 0.05) and a significant negative association with positive communication (β= -0.050, p< 0.01). In addition, kin relationship demonstrated a significant positive relationship with this measure (β= 0.146, p< 0.05); caregivers who were not spouses reported higher feelings of anger.

For positive affect, none of the communication patterns showed significant associations. However, the IWD's ability to perform ADLs, did show a significant, negative association with positive affect (β= -0.176, p< 0.05). That is, the less dependent an IWD was on a caregiver, the less positive affect reported by the caregiver.

In closing, I found that depressive communication had a significant positive association with caregiver anger and depression, aggressive communication had a significant positive association with caregiver depression and overload, and positive communication showed a significant negative association with caregiver depression and anger.

Table 3 Multiple Linear Regressions

	Depression	**Anger**	**Overload**	**Positive Affect**
	β (s.e)	β (s.e)	β (s.e)	β (s.e)
Aggressive Communication	0.145*	0.007	0.059*	-0. 046
	(4.999)	(0.019)	(0.024)	(0.052)
Depressive Communication	0. 114*	0.050***	0.034	-0.008
	(0.051)	(0.014)	(0.017)	(0.037)
Positive Communication	-0.423**	-0.186***	-0.050**	0.203
	(0.152)	(0.041)	(0.052)	(0.111)
Caregiver Education	-0.108	0.028	-0.144	-0.264
	(0.312)	(0.084)	(0.108)	(0.229)
IWD ADL total	0.119	-0.051*	0.054	-0.156*
	(0.084)	(0.023)	(0.029)	(0.063)
Spouse vs. Other	-0. 489	0. 848*	1.044*	0.927
	(1.387)	(0.373)	(0.478)	(1.020)
Model *R*-square	0.140	0.181	0.146	0.070
F	5.570***	7.535***	5.873***	2.565*

Note: IWD= Individual with Dementia, ADL=Activities of Daily Living, Dyad *N*=214
**p*<0 .05; ***p* <0 .01; ****p*<0.001

Study 2: Longitudinal Analysis

After determining these cross-sectional results, I opted to investigate the association of changes in communication styles and change over time in the four outcome variables: depression, anger, overload, and positive affect. I considered four waves of interviews: baseline, 3 months, 6 months and 12 months.

I used an auto regression (AR1) error structure (shown in Table 4) for every model in the MLM analysis to control for changes from one wave to the next. This structure ensured that the models fit the data well. The first column presented in Table 4 shows caregiver depression as the outcome variable. Using MLM in a preliminary analysis, I modeled the possible time trends (linear, quadratic, and cubic) in changes of depression. In this model, I did not find any general time trend for between-person longitudinal change in levels of depression. Significant random intercepts showed that caregivers differed individually in their overall levels of depression over time (σ^2=45.905, p<.001). However, the between-person level of depression barely changed over the four waves. That is, there was not a significant increasing or decreasing trend over time for caregiver depression.

In the second set of analyses, I entered communication patterns over time to explain within-person associations in depression over time. In this analysis, I also controlled for caregivers' education, kin relationship types, and IWDs' functional dependency. The aggressive communication variable yielded a significant positive relationship (β= .156, p< 0.01), and

positive communication showed a significant negative relationship (β= - .199, p<0.05) as predictors of caregiver depression over time. In other words, higher aggressive communication and lower positive communication were both associated with higher caregiver depression. Among the covariates, the IWD's ability to perform ADLs also demonstrated a significant positive association with within-person depression. Specifically, as the ADL score increased over time, caregiver depression also increased. None of the other control variables were significantly associated with caregiver depression.

The second column presented in Table 4 investigated caregiver anger over time as the dependent variable. My preliminary analysis did not reveal a between-person longitudinal trend using time as the within-person predictor. Nonetheless, the significant random intercept showed that caregivers had significant between-person differences in their overall level of anger (σ^2=3.773, p<.001). In the second set of analyses, using communication variables as predictors, I found significant covariations between all three of the communication predictors and caregiver anger. That is, aggressive and depressive communication as predictors showed significant positive associations (β= .039, p< .001; β= .03, p< .01) and positive communication showed a significant negative association (β= -.08, p< .01) with caregiver anger. Thus, higher aggressive and depressive communication were associated with more caregiver anger, whereas higher positive communication was associated with lower caregiver anger over time. None of the covariates (kin relationship, IWD's ADLs dependency, or caregiver education) showed significant associations with caregiver anger.

Next, I analyzed caregiver overload as a dependent variable (shown in Table 4). Unlike the depression and anger analyses, this analysis revealed a linear time trend of longitudinal change in overload. Time, as a within-person predictor, demonstrated a significant negative relationship between caregiver overload, showing decreasing level of role overload over time (β= -.19, p=.013).

When I performed the second set of analyses (shown under "Overload, Model 2" in Table 4) by adding communication patterns into the model along with the linear time predictor, linear time remained a significant predictor (β=-.16, p=.03). The random intercept indicated significant between-person variations in overall levels of caregiver overload (σ^2=5.558, p<.001). Additionally, depressive and aggressive communication both displayed significant positive relationships as predictors of changes in overload over time (β=.03, p=0.004; β=.05, p=0.0002). These effects suggested that decreasing depressive and aggressive communication were associated with decreasing overload over time. In addition, positive communication as a predictor of caregiver overload showed a significant negative relationship, suggesting that as caregiver overload decreased, positive communication increased. None of the other covariates (kin relationship, IWD's ADLs dependency, or caregiver education) were significant.

Positive affect (shown in table 4) as an outcome variable showed a borderline significant linear time trend for longitudinal change in the preliminary analysis (β=-.32, p=.08). When the communication pattern variables were added to the model as additional within-person predictors, the linear time effect was no longer significant. The random intercept showed significant between-person variability in caregivers' general level of positive affect over time (σ^2=26.567, p<.001). Positive communication showed a significant positive association with positive affect (β=.17, p=.03). That is, lower positive communication was associated with lower positive affect over time. As for the other covariates, the IWD's ability to perform ADLs showed a significant

negative effect. Thus, the IWD's decreased ability to perform ADLs was related to increased positive affect. The rest of covariates were not significant.

Table 4 Multilevel Modeling (MLM) Results

	Depression	**Anger**	**Role Overload**		**Positive Affect**	
	β (s.e.)	β (s.e.)	β (s.e.)		β (s.e.)	
Fixed effects			Model 1	Model 2	Model 1	Model 2
Intercept	14.560***	3.393**	11.750***	10.103***	22.306***	26.338***
	(4.310)	(1.110)	(0.217)	(1.3810)	(0.486)	(3.177)
Linear time			-0.187*	-0.157*	-0.319 †	-0.254
			(0.075)	(0.074)	(0.185)	(0.183)
Aggressive Communication	0.156***	0.039***		0.051***		-0.016
	(0.041)	(0.012)		(0.013)		(0.033)
Depressive Communication	0.059	0.030**		0.032**		-0.009
	(0.034)	(0.010)		(0.011)		(0.028)
Positive Communication	-0.199*	-0.083**		-0.063		0.169*
	(0.100)	(0.028)		(0.032)		(0.078)
IWDs' ADLs function	0.189**	-0.001		0.037†		-0.157**
	(0.062)	0.017		(0.021)		(0.049)
Caregiver's Education	-0.297	-0.041		-0.059		-0.213
	(0.274)	(0.070)		(0.088)		(0.2)
Spouse vs. Other	-0.295	0.641*		0.852*		0.947
	(1.216)	(0.310)		(0.389)		(0.885)
Random effects						
Intercept VAR (σ^2)	45.905***	3.773***	5.879***	5.558***	22.013***	26.567***
	(11.825)	0.562	(0.919)	(0.751)	(5.306)	(3.901)
Residual VAR	64.3715***	4.219***	5.636***	4.716***	36.734***	30.620***
	(10.214)	0.350	(0.625)	(0.346)	(4.575)	(2.216)
AR(1)	0.398***	0.002	0.215*		0.295**	
	(0.100)	(0.081)	(0.096)		(0.092)	
$-2LL$	4520.200	2964.600	3070.700	2856.800	4184.500	3940.300
AIC	4526.200	2970.600	3076.700	2860.800	4190.500	3944.300

Note: Dyad *N*= 106-214, ADL= Activities of Daily Living
†p< 0.1; *p< 0.05; **p < .01; ***p<.001

Discussion

Cross-Sectional Study

I aimed to explore the various patterns of communication expressed by IWDs and their effects on caregiver well-being. The cross-sectional analysis revealed that communication patterns indicating negative affect (aggressive and depressive communication) displayed by IWDs resulted in similarly negative outcomes (caregiver depression, anger, and overload) for the caregiver. Taken separately, I found that depressive communication patterns from IWDs predicted higher depression and anger in caregivers. Likewise, more aggressive communication was related to more caregiver depression and feelings of overload. On the other hand, positive

communication patterns from IWDs were associated with less caregiver anger and depression. Altogether, the analyses indicated that aggressive and depressive communication items lent to more feelings of caregiver burden, and positive communication was associated with less of these feelings, confirming the original hypotheses.

To my surprise, this cross-sectional analysis did not show a significant relationship between positive communication and positive affect. This lack of significance could be related to the relatively small sample size (only 214 dyads) as well as the complex relationship between aspects of the caregiving relationship and positive outcomes. Current research suggests that positive affect is associated with several factors, including presence of an adequate support system (Farran, 1997). Perhaps for the caregivers in the current study, positive affect is more strongly associated with factors such as support than with communication patterns.

As a follow-up cross-sectional study, researchers could investigate the correlation between these dimensions of communication and positive affect, depression, and anger outcomes among IWDs. If results similar to the current study could be replicated in the follow-up, there would be sufficient evidence to conclude that the aggressive and depressive forms of communication are related to negative outcomes for both caregivers and receivers. This conclusion would further support the need for interventions to improve outcomes for both caregivers as well as IWDs.

Longitudinal Study

All four of the longitudinal models showed significant between-person variability in caregivers' overall affective well-being, as estimated by the intercept variances. There were no significant between-person time trends for depression and anger. Although the slopes for these models were not significant, I attribute the between-person differences to the differing communication patterns among the dyads. In both of these two models, I found within-person associations between the communication patterns and caregivers affective well-being.

In contrast, role overload and positive affect as outcomes both showed negative time trends. Specifically, role overload demonstrated significant within-person associations between communication patterns and caregiver affect in tandem with the negative time trend. For positive affect as an outcome, the within-person association with time disappeared after the communication patterns were added as predictors. Nonetheless, positive affect had a significant association with positive communication as predictor.

Results indicated that two of the four outcome variables (caregiver depression and anger) did not have a significant relationship with time as a predictor. Several reasons could account for the lack of significance in these patterns of affective change over time. For example, between waves one and four, about half of the original sample dropped from the study. It is possible that the most angry and depressed caregivers were more likely to be ineligible for the study after placing their relatives in nursing facilities. Another important consideration concerns the relatively short period of time (12 months) covered by waves one through four. If these variables were measured over a longer period of time, more clear trends might emerge.

In addition, past research has noted that multiple factors are correlated with both caregiver anger and depression measures. For example, background characteristics (age, race,

financial income, hours spent caregiving) of both caregivers and IWDs are associated with caregiver depression (Covinsky et al, 2003). Similarly, caregiver anger has been connected to critical and hostile attitudes (Dunkin et al, 1998), among other sources of stress. These complex relationships between possible confounds and my outcome variables could contribute to the lack of a significant time trend. Nonetheless, the results from the MLM did confirm the cross-sectional study's findings about the associations between the various patterns of communication and caregiver outcomes.

Role overload as a caregiver outcome, revealed a negative time trend along with aggressive and depressive communication patterns. The items contained in the aggressive and depressive communication measures (crying, verbal threats, and comments about death) would logically contribute to the stress associated with caregiver overload and burnout, and so I expected this outcome to increase over time. However, over the period of four waves, this measure showed a steady decline. Past research has noted that overload correlates with a caregiver's sense of mastery (Aneshensel et al, 1993). Thus, if caregivers felt more able to tackle the demands of their roles over time, a decline in feelings of overload would seem reasonable**.** Although the opposite would normally be expected, the results indicate that overload is positively associated with the IWD's ability to perform ADLs. According to previous literature, over time, caregivers may expect decreased ability of the IWD to perform ADLs, allowing them to anticipate more dependency from the IWD. As a result, the caregiver may gradually adapt to handling these changes in dependency, decreasing feelings of overload (Aneshensel et al., 1993).

Finally, I confirmed a significant negative time trend for positive affect, but this trend disappeared when other predictors were considered. The decrease in positive affect over time as a result of caregiving seems logical, considering the declining health of the IWD and addition of caregiving responsibilities. Still, as previously mentioned, the complex relationship between various predictors and positive affect could lead to effects from confounding variables (Farran, 1997). These effects could explain the lack of a significant time trend with the communication patterns.

As a future direction, a structural equation model could be constructed to further examine the causal relationships between communication and caregiver overload, depression, anger, and positive affect. Such a model would be able to more directly determine the causal effect of communication predictors on the affective outcomes.

Overall Interpretation

Why do IWDs exhibit these aggressive and depressive communication behaviors in the first place? Drawing from previous literature, these individuals likely experience difficulty achieving simple wants and needs, as well as more complex communication goals (social closeness and information transfer) (Light, 1988; Blackstone, 1996). Therefore, it is plausible that the depressive and aggressive behaviors are related to the IWD's decreased ability to communicate. According to Smith and Buckwater (2005), behavioral symptoms such as those analyzed in the current study are almost always attempts to communicate in spite of impaired language ability.

In this study, I found that positive communication was associated with decreased feelings of caregiver burden. Therefore, to decrease overall caregiver burden, it is necessary to decrease aggressive and depressive communication and increase positive communication as much as possible. In order to increase such positive communication, IWDs must have the ability to successfully communicate without resorting to such depressive and aggressive communication behaviors. Thus, it is necessary to employ communication strategies for both caregivers and receivers.

The positive communication exhibited by IWDs could relate to a caregiver's willingness to encourage verbal communication from the IWD, in spite of deficits related to the relative's dementia. Interventions constructed to increase such positive communication, should, according to my findings, decrease aggressive and depressive communication, as well as overall caregiver burden. The results of this study reinforce the importance of successful communication between the IWD and caregiver, not just for the sake of the IWD himself, but also for the caregiver's well-being. Future research must focus on developing and employing interventions for IWDs to communicate more successfully, so that they will not resort to these aggressive and depressive compensating behaviors.

These findings support previous research regarding the behaviors of IWDs and their effects on caregiver burden (Pasporouvov, 2011; Gallagher et al, 1989). Bourgeois et al (2010) describe a number of AAC tools developed to assist IWDs to communicate successfully with caregivers. For example, low-tech communication tools, including boards and memory books, can alleviate memory and word-finding problems. Bourgeois suggests that AAC therapy for IWDs may also require training for caregivers to learn how to guide interactions. In addition, Orange (1998) notes the importance of teaching caregivers proper strategies to encourage conversation with IWD.

Still, as described by Young et al (2011), information for caregivers and professionals who work with IWDs regarding communication strategies is not always readily available. According to Young's study, professionals and caregivers reported that the communication advice available was extremely general and lacked credibility (Young et al, 2011). Such techniques encouraging positive communication could be incorporated into informal interventions (such as in the form of presentations at Alzheimer's Association meetings) and should be readily available for both caregivers and IWDs. However, the previously mentioned studies do not specifically suggest the possibility of combining IWD and caregiver conversational strategies as a way to improve communication between the dyad. That is, many of the studies focus on either the IWD or the caregiver to improve communication rather considering both parties as responsible for successful interaction. Future research could focus on ways to improve communication techniques between caregivers and individuals with dementia as a dyad to reduce negative and improve positive outcomes.

Limitations

Several limitations exist within this study. First, attrition between the baseline and fifth waves resulted in a much smaller final sample size. However, this type of attrition is practically unavoidable considering the nature of the study. Many of the IWDs in the study were in a compromised physical state due to dementia and old age. As a result, several participants

transferred to a long-term care facility or passed away over the course of the year (Kim et al., 2011).

Another limitation concerns the use of the WRB itself. Although the WRB contains fifty-three dementia related behaviors, none of the twelve categories address communication directly. Therefore, in order to use this dataset for the hypotheses, I had to construct my own communication measures out of the behaviors assessed in the WRB. Future studies that wish to investigate communication patterns between caregivers and IWDs should utilize questionnaires that target communication needs more directly. Erder et al (2012), recently presented a new measure of caregiver burden that examines communication patterns and social interactions between caregivers and IWDs. The Caregiver Perceived-Burden Questionnaire (CPBQ) was designed to measure these specific domains of function in IWDs and their effects on caregivers. Such a scale would be ideal to use for a future longitudinal study considering communication and caregiver burden.

Future studies might also consider observing caregivers and care-receivers to monitor interactions more directly. Such an approach could be employed to determine how caregivers respond to types of communication exhibited by IWDs. This method would also eliminate reporting errors by caregivers regarding how frequently each communication item occurred.

Finally, the current study attempts to describe the aggressive and depressive communication behaviors exhibited by IWDs and does not assess the presence of communication disorders. Unfortunately, the Family CARES survey did not include information about the types of rehabilitation services each IWD received during the study, and the WRB does not contain information on IWD's communication disorders specifically. Thus, it proved difficult to assess particular aspects of the IWDs ability to communicate and, thereby, determine the particular therapy that would be most useful to IWDs in the study. Future studies of this nature should seek to obtain information about the participants' experience with speech therapy services.

References

Aggarwal, N., Vass, A. A., Minardi, H. A., Ward, R., Garfield, C., & Cybyk, B. (2003). People with dementia and their relatives: personal experiences of Alzheimer's and of the provision of care. *Journal of Psychiatric and Mental Health Nursing, 10*(2), 187-197.

Alden, Linda (06/01/2003). "Recognizing and coping with caregiver burnout". *Inside case management (1073-6514),*10 (6), p. 12.

Aneshensel, C. S. (1995). *Profiles in caregiving: The unexpected career*. San Diego: Academic Press

Banerjee, S., Willis, R., Graham, N., & Gurland, B. J. (2010). The Stroud/ADI dementia quality framework: a cross-national population-level framework for assessing the quality of life impacts of services and policies for people with dementia and their family carers. *International journal of geriatric psychiatry,25*(3), 249-257.

Blackstone, S. (1996). The third thirty: Keep on communicating. *Augmentative Communication News, 9(2),* 1–2.

Bourgeois, M. S., Dijkstra, K., Burgio, L., & Allen-Burge, R. (2001). Memory aids as an augmentative and alternative communication strategy for nursing home residents with dementia. *Augmentative and Alternative Communication, 17*(3), 196-196. Retrieved from http://search.proquest.com/docview/220522428?accountid=13158

Bourgeois, M., Fried-Oken, M. & Rowland, C. (2010). AAC strategies and tools for persons with dementia.*ASHA Leader, 15*(3), 8.

Buller, N., & Ptok, M. (2005). Impairment of speech and communication skills in dementia. *Hno, 53*(2), 177.

Burgio, L. D., Allen-Burge, R., Roth, D. L., Bourgeois, M. S., Dijkstra, K., Gerstle, J., . . . Bankester, L. (2001). Come talk with me: Improving communication between nursing assistants and nursing home residents during care routines. *The Gerontologist, 41*(4), 449-460. doi: 10.1093/geront/41.4.449

Covinsky, K. E., Newcomer, R., Fox, P., Wood, J., Sands, L., Dane, K., & Yaffe, K. (2003). Patient and caregiver characteristics associated with depression in caregivers of patients with dementia. *Journal of General Internal Medicine, 18*(12), 1006-1014.

Derogatis, L. R., Lipman, R. S. & Covi, L. (1973). The SCL-90: An outpatient psychiatric rating scale. *Psychopharmacology Bulletin, 9,* 13-28.

Dunkin, J. J., & Anderson-Hanley, C. (1998). Dementia caregiver burden A review of the literature and guidelines for assessment and intervention. *Neurology, 51*(1 Suppl 1), S53-S60.

Egan, M., Bérubé, D., Racine, G., Leonard, C., & Rochon, E. (2010). Methods to enhance verbal communication between individuals with alzheimer's disease and their formal and informal caregivers: A systematic review. *International Journal of Alzheimer's Disease, 2010,* 1-12. doi:10.4061/2010/906818

Erder, M. H., Wilcox, T. K., Chen, W., O'Quinn, S., Setyawan, J., & Saxton, J. (2012). A new measure of caregiver burden in alzheimer's disease: The caregiver-perceived burden questionnaire. *American Journal of Alzheimer's Disease and Other Dementias, 27*(7), 474-482. doi:10.1177/1533317512456449

Farran, C. J. (1997). Theoretical perspectives concerning positive aspects of caring for elderly persons with dementia: Stress/adaptation and existentialism. *The Gerontologist, 37*(2), 250-257.

Fauth, E. B., Zarit, S. H., Femia, E. E., Hofer, S. M., & Stephens, M. A. P. (2006). Behavioral sand psychological symptoms of dementia and caregivers' stress appraisals: Intra-individual stability and change over short-term observations. *Aging and Mental Health, 10*(6), 563-573.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research,12*(3), 189-198.

Gallagher, D., Rose, J., Rivera, P., Lovett, S., & Thompson, L. W. (1989). Prevalence of depression in family caregivers. *The Gerontologist, 29*(4), 449-456. doi:10.1093/geront/29.4.449

Germain, S (2009). "Does cognitive impairment influence burden in caregivers of patients with Alzheimer's disease?". *Journal of Alzheimer's disease (1387-2877), 17* (1), p. 105.

Haberstroh, Julia (2011). "TANDEM: Communication training for informal caregivers of people with dementia". *Aging & mental health (1360-7863), 15* (3), p. 405.

Hendryx-Bedalov, P. M. (2000). Alzheimer's dementia. coping with communication decline. *Journal of Gerontological Nursing, 26*(8), 20.

Katzman, R., & Fox, P. J. (1999). The World-Wide Impact of Dementia. Projections of Prevalence and Costs. In *Epidemiology of Alzheimer's disease: From gene to prevention* (pp. 1-17). Springer Berlin Heidelberg.

Kim, K., Zarit, S. H., Femia, E. E., & Savla, J. (2012). Kin relationship of caregivers and people with dementia: Stress and response to intervention. *International Journal of Geriatric Psychiatry, 27*(1), 59-66. doi:10.1002/gps.2689

Kramer, B. J. (1997). Gain in the caregiving experience: Where are we? what next? *The Gerontologist, 37*(2), 218-232. doi:10.1093/geront/37.2.218

Lau, D.T., Berman, R., Halpern, L., Pickard, A.S., Schrauf, R., & Witt, W. (2010). Exploring factors that influence informal caregiving in medication management for home hospice patients. *Journal of Palliative Medicine, 13(*9), 1085-90

Lawton, M. P., & Brody, E.M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. *The Gerontologist*, 9, 179-186.

Light, J. (1988). Interaction involving individuals using augmentative and alternative communication: State of the art and future research directions. *Augmentative and Alternative Communication, 4*, 66–82.

Light, J. (1997). “Communication is the essence of human life”: Reflections on communicative competence. *Augmentative and Alternative Communication*,*13*(2), 61-70.

Littell, R. C., Miliken, G. A., Stroup, W. W., & Wolfinger, R. D. (1996). *SAS systems for mixed models*. Cary, NC: SAS Institute.

Lubinski, R. (1995). *Dementia and communication*. San Diego, Ca: Singular Pub. Group.

Milićević-Kalašić, Aleksandra (2009). “Caregivers care with Alzheimer’s disease, prevention of caregivers burn-out.” (pp. 67-71). Berlin, Heidelberg: Springer Berlin Heidelberg. doi: 10.1007/978-3-642-00326-4_5

Nussbaum, J. F. (2000). *Communication and aging*. Mahwah, NJ: L. Erlbaum.

Orange, J.B. (1991b). Perspectives of family members regarding communication changes. In R.Lubinski (Ed.), Dementia and communication (pp. 168–186).

Orange, J. B., Van Gennep, K. M., Miller, L., & Johnson, A. M. (1998). Resolution of communication breakdown in dementia of the Alzheimer's type: A longtitudinal.. *Journal Of Applied Communication Research*, *26*(1), 120-138.

Papastavrou, Evridiki (08/01/2011). "Caring and coping: the dementia caregivers". *Aging & mental health (1360-7863)*, 15 (6), p. 702.

Papastavrou, E., Kalokerinou, A., Papacostas, S. S., Tsangari, H. and Sourtzi, P. (2007), Caring for a relative with dementia: family caregiver burden. Journal of Advanced Nursing, 58: 446–457. doi: 10.1111/j.1365-2648.2007.04250.x

Pearlin, L. I., Mullan, J. T., Semple, S. J., & Skaff, M. M. (1990) Caregiving and the stress process: An overview of concepts and their measures. The Gerontologist, 30, 583-594.

Rabins, P. V., Mace, N. L., & Lucas, M. J. (1982). The impact of dementia on the family. *JAMA : The Journal of the American Medical Association*, *248*(3), 333-335. doi:10.1001/jama.1982.03330030039022

Radloff, L. (1977). The CES-D Scale: A self-report depression scale for research in the general population. Applied Psychological Measurement, 1, 385-401.

Rau, M. T., & National Council of Senior Citizens. (1993).*Coping with communication challenges in alzheimer's disease*. San Diego, Calif: Singular Pub. Group.

Richter, Judith M. (10/1995). "Communicating with persons with Alzheimer's disease: experiences of family and formal caregivers". *Archives of psychiatric nursing (0883-9417)*, 9 (5), p. 279.

Robinson, Karen M. (11/2001). "Problem behaviour, caregiver reactions, and impact among caregivers of persons with Alzheimer's disease". Journal of advanced nursing (0309-2402), 36 (4), p. 573.

Santo Pietro, Mary Jo. (2008). Assessing the communicative styles of caregivers of patients with alzheimer's disease.*Seminars in Speech and Language*, *15*(3), 236-254.

Savundranayagam, M. Y., Hummert, M. L., & Montgomery, R. J. (2005). Investigating the effects of communication problems on caregiver burden. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *60*(1), S48-S55.

Singer, J. D., & Willett, J. B. (2003). Applied longitudinal data analysis: Modeling change and event occurrence. Oxford: Oxford University Press.

Small, J. A., Geldart, K., & Gutman, G. (2000). Communication between individuals with dementia and their caregivers during activities of daily living.*American Journal of Alzheimer's disease and other Dementias*, *15*(5), 291-302

Small, J. A., Gutman, G., Makela, S., & Hillhouse, B. (2003). Effectiveness of communication strategies used by caregivers of persons with alzheimer's disease during activities of daily living. *Journal of Speech, Language, and Hearing Research*, *46*(2), 353-67. Retrieved from http://search.proquest.com/docview/230791549?accountid=13158

Smith, M., & Buckwalter, K. (2005). Behaviors associated with dementia: Whether resisting care or exhibiting apathy, an older adult with dementia is attempting communication. nurses and other caregivers must learn to 'hear' this language. *The American Journal of Nursing*, *105*(7), 40.

Son, J., Erno, A., Shea, D. G., Femia, E. E., Zarit, S. H., & Stephens, M. A. P. (2007). The caregiver stress process and health outcomes. Journal of aging and health, 19(6), 871-887.

Song, L., Northouse, L.L., Zhang, L., Braun, T.M., Cimprich, B., Ronis, D.L., & Mood, D.W. (2012). Study of dyadic communication in couples managing prostate cancer: a longitudinal perspective. *Psychooncology*. *21*(1), 72-81.

Tellegen, Auke, D. Watson, & L. A. Clark. "Development and validation of brief measures of positive and negative affect: The PANAS scales." Journal of personality and social psychology 54.6 (1988): 1063-1070.

Teri, L., Truax, P., Logsdon, R., Uomoto, J., Zarit, S., & Vitaliano, P. P. (1992). Assessment of behavioral problems in dementia: the revised memory and behavior problems checklist. *Psychology and aging*, *7*, 622-622.

Vitaliano, P. P., Russo, J., Young, H. M., Teri, L., & Maiuro, R. D. (1991). Predictors of burden in spouse caregivers of individuals with Alzheimer's disease. *Psychology and aging*, *6*(3), 392.

Williams, K. N., Herman, R., Gajewski, B., & Wilson, K. (2009). Elderspeak communication: Impact on dementia care. *American Journal of Alzheimer's Disease and Other Dementias*, *24*(1), 11.

Young, T. J., Manthorp, C., Howells, D., & Tullo, E. (2011). Developing a career communication intervention to support personhood and quality of life in dementia. *Ageing and Society*, *31*(6), 1003-1025. doi:http://dx.doi.org/10.1017/S0144686X10001182

Zarit, S. H., Orr, N. K., & Zarit, J. M. (1985). *The hidden victims of alzheimer's disease: Families under stress*. New York: New York University Press.

The Impact of Endophytic Fusarium verticillioides on Corn Growth and Protein Composition

Patrick Thomas, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Gretchen A. Kuldau, Ph.D.
Associate Professor of Plant Pathology
Department of Plant Pathology and Environmental Microbiology
College of Agricultural Sciences
The Pennsylvania State University

ABSTRACT

Endophytic *Fusarium verticillioides* has become an emerging issue in crop and food safety. This study looks at the effects of various strains of endophytic *F. verticillioides* on the growth and protein makeup of corn (*Zea mays).* A total of 360 plants were inoculated for three treatments, with height being measured every seven days. After approximately 21 days, samples were taken from each treatment to determine if endophytic colonization occurred. Samples were also analyzed by SDS-PAGE and visualized by silver staining to evaluate any differences in the apoplastic fluid of each treatment. This study showed that there was no significant difference ($p>0.05$) in plant height between infected and non-infected plants but there were differences noted in plant physiology and protein composition.

INTRODUCTION

This year, the United States produced almost 100 million acres of corn to satisfy global demand for food and fuel. Given the vast yield of corn, growers face a wide range of challenges, which include an emergence of pathogens that limit corn growth and production such as *Fusarium verticillioides*. Research shows that the fumonisins produced by this fungus may affect the plant host. Fumonisins (FB_1, FB_2 and FB_3) negatively affect numerous animals with life-threatening diseases such as brain damage and pulmonary edema (Yates et al., 1997). As a result, many studies investigate the relationship between corn physiology and the effects of pathogenic and endophytic *F. verticillioides* (Yates, 1997). Although some scholars conclude that the fungus impacts crop growth, few studies discuss why these varying effects occur. Therefore, this project

will inoculate corn with different strains of endophytic *F. verticillioides* in an effort to better understand their effect on corn growth and physiology.

Fungi are documented for the variety of relationships they have with plants. While some are mutualistic (e.g. mycorrhizae) or commensalistic, some fungi are pathogenic and have negative effects on plant growth and physiology, such as *F. verticillioides*. *F. verticillioides* can have a varying impact on corn plants when infected. Strains of *F. verticillioides* can either function as a plant pathogen or as an endophyte (Yates et al., 1997; Leslie and Summerell., 2006). Resulting diseases may include ear rot, stalk rot and seedling blight and it can also survive in crop debris and infect crops planted at later dates (Munkvold, 1997; Bacon, 1992). However, when existing as an endophyte, the fungus exists in a symptomless manner primarily between the cell walls and intercellular spaces (apoplast) of the stalk and leaves (Hammerschmidt, 2010; Bacon et al., 1992). Once established, fumonisin production may begin in the roots, mesocotyl and nodes and may eventually contain the highest concentrations of these toxins (Yates, 1997). Fumonisins, along with deoxynivalenol (DON) and trichothecens (T-2) are all secondary metabolites produced by *Fusarium* fungi that are classified as mycotoxins: toxic secondary metabolites formed by a fungus that are toxic to humans and animals in low doses (Woloshuk, 2012; Bennett, 2003).

Of these mycotoxins producing *Fusarium*, endophytic *F. verticillioides* and the mycotoxin fumonisin have been of significant interest since their discovery. Fumonisins FB_1, FB_2 and FB_3 were successfully isolated and characterized from *Fusarium moniliforme* (recently renamed *F. verticillioides*) strain MRC 826 in 1988 (Marasas, 1996). Two years later, a spike in leukoencephalomalacia (LEM) in horses and pulmonary edema syndrome (PES) in pigs occurred in the United States and researchers were soon able to link the consumption of fumonisin-infected corn back to the disease outbreaks by feeding horses fumonisin-infected corn (Marasas, 1996).

While there are over 28 naturally occurring fumonisins, the most common and impactful is FB_1, followed by FB_2 and FB_3 (Rheeder, 2002). Fumonisins are a hydrocarbon chain with two tricarballylic acid groups and an amino terminus, which bears resemblance and structure to sphingolipids (Figure 1). Sphingolipids are lipids responsible for a range of functions including forming cell membranes, maintaining cell membrane structure and facilitating cell signaling (Marasas, 1996). When present, the fumonisins have the potential to inhibit ceramide synthase. As a result, some cell communication is compromised. In some cases, it has been documented that the resulting block of ceramide synthase activity can be used as a biomarker to indicate fumonisin toxicity. Fumonisins also have the potential to inhibit folate transport. The blocking of folate and folic acid transport can cause certain birth defects, which include exencephaly (the newborn's brain located outside of the body) and neural tube defects (NTD). While the cause of NTD or folate/folic acid's impact on preventing them isn't clear, research has been able to provide a possible link to the impact fumonisins have on these birth defects (Marasas, 2004).

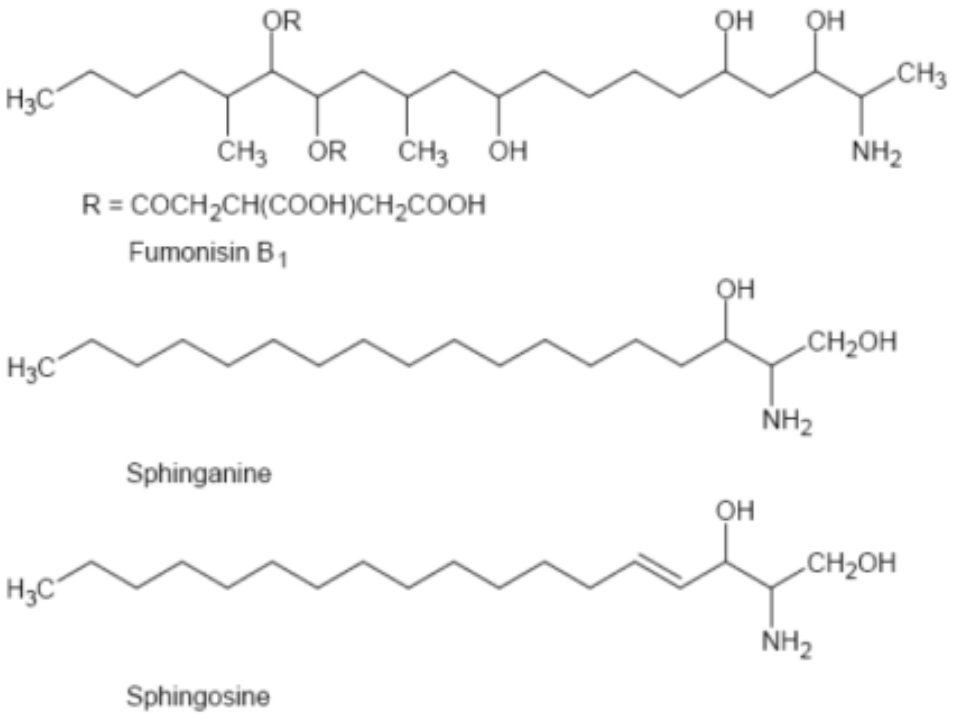


Figure 1. Fumonisin B_1, Sphinganine and Sphinosine Structure

Fusarium Toxins. Digital image. *Engormix*. N.p., 12 Aug. 2008. Web. 12 June 2013. <http://en.engormix.com/MA-mycotoxins/articles/fumonisins-mycotoxins-increasing-importance-t1109/255-p0.htm>.

In 2004, a study documented the effects in female mice of ingesting fumonisin-infected corn had on the development of their newborns. When the mothers ingested a corn diet containing 20 ppm FB_1 per kilogram body weight, 79% of newborn mice were diagnosed with exencephaly, while no such effects were found in the control group. When ingesting a 10 ppm diet, at least 24% of mice had observable neural tube defects. As a result of this study, the correlation between human fumonisin consumption (via homemade corn tortillas) and neural tube defects was formed (Marasas, 2004). Other studies have discovered that liver and kidney tumors became present in mice when ingesting as little as 50 ppm FB_1 in corn regularly over a two year period (Voss, 2002).

Fumonisin-contaminated animal feed was also an issue in the United States. When endophytic *F. verticillioides* and fumonisins were first characterized, corn samples were collected and tested for FB_1 in the central US from 1988 to 1995. Samples had a mean FB_1 level of 1 – 3 µg/g (ppm) with samples reaching levels as high as 5 – 38 µg/g. From 1989-1990, an LEM outbreak occurred resulting in 135 horses dying. When corn feed samples were taken, samples ranged from 1 – 126 µg/g with two-thirds of samples being above 10 µg/g. A pulmonary edema outbreak also occurred in 1989 that resulted in

1,100 swine dying in Iowa. In those fields that had documented outbreaks, FB_1 levels ranged from 3 – 330 µg/g. However in 51 fields that were classified as "non-outbreak" fields, all samples were under 10 µg/g (Desjardins, 2006). Tables 1A and 1B show the FDA Guidelines to Industry on fumonisins (FB_1 + FB_2 + FB_3 in food or animal feed (FDA, 2011).

Table 1A. Guidance for Industry Fumonisin Levels in Human Foods, According to the FDA (FDA, 2011).

Product	Total Fumonisins Allowed (FB_1 + FB_2 + FB_3) (in parts per million)
Degermed dry milled corn products (e.g., flaking grits, corn grits, corn meal, corn flour with fat content of < 2.25%, dry weight basis)	2 ppm
Whole or partially degermed dry milled corn products (e.g., flaking grits, corn grits, corn meal, corn flour with fat content of ≥ 2.25 %, dry weight basis)	4 ppm
Dry milled corn bran	4 ppm
Cleaned corn intended for masa production	4 ppm
Cleaned corn intended for popcorn	3 ppm

Table 1B. Guidance for Industry Fumonisin Levels in Animal Feed, According to the FDA (FDA, 2011).

Corn and Corn By-products intended for:	Total Fumonisins Allowed (FB_1 + FB_2 + FB_3) (in parts per million)
Equids and rabbits	5 ppm (no more than 20% of diet)**
Swine and catfish	20 ppm (no more than 50% of diet)**
Breeding ruminants, breeding poultry and breeding mink*	30 ppm (no more than 50% of diet)**
Ruminants ≥ 3 months old being raised for slaughter and mink being raised for pelt production	60 ppm (no more than 50% of diet)**
Poultry being raised for slaughter	100 ppm (no more than 50% of diet)**
All other species or classes of livestock and pet animals	10 ppm (no more than 50% of diet)**
*Includes lactating dairy cattle and hens laying eggs for human consumption **Dry weight basis	

Fumonisin toxicity issues have also occurred internationally. In 2005, research was conducted in Benin, West Africa to evaluate the fumonisin levels of silage stored corn in samples located in rural regions. Fumonisin levels in these samples ranged from 8,240 – 16,690 µg/kg. However, it should be noted that after a six-month storage period, fumonisins levels decreased significantly and fumonisins levels also dropped when the moisture content was under 19% (Fandohan, 2005). In Brazil, which is the third largest producer of corn worldwide, a study was done to look at fumonisin levels in corn samples in areas that had high rates of esophageal cancer. In the Santa Catarina region, samples tested had fumonisins levels from 2,890 µg/kg to as high as 18,740 µg/kg and it was concluded that areas of high levels of fumonisin may correlate with the high rates of esophageal cancer (van der Westhuizen, 2003). Further studies conducted by the IARC showed that fumonisin B_1 fit the parameters as a Category 2B carcinogen; that is possibly carcinogenic to humans (IARC, 1992)

While there is a good understanding of endophytic *F. verticillioides* inhabitance in plants, its impact on plant physiology is still being determined. Research conducted with endophytic *F.verticillioides* strain RRC 374 looked at the difference in the cell composition of infected and non-infected corn. Initially, there was a significant difference in the location of chloroplasts in bundle sheath cells, and height of shoots during the first 7 days after planting. However, there was no significant difference in plant height or shoot diameter between infected and non-infected corn plants at the conclusion of the experiment. There was a significant difference in root length and composition, with infected corn plants having longer roots and more secondary roots (Yates, 1997). While the results bring discussion about the specific impacts of endophytic *F.verticillioides*, the use of only one strain limits the conclusions that can be made.

While numerous studies have looked at the physiological effects of *F. verticillioides* and FB_1, many of these studies have only looked at one strain's effect. The experiment that will be conducted by this researcher will look at two different strains of *F. verticillioides:* M-1552, a weak fumonisin forming strain and M-3125, a strong fumonisin forming strain (Zitomer, 2006). Comparing these two isolates in experimental trials through an assessment of corn growth and apoplastic make-up will provide a better explanation to the behavior of certain *F. verticillioides* strains. While *F. verticillioides* has a range of hosts, corn is of the most economic importance, justifying its use in this series of experiments (Schmale III, 2013).

RESEARCH QUESTIONS

The research questions being addressed in this series of experiments include:

1. Is there a significant difference in growth when corn plants are infected by various strains of *F. verticillioides* (M-3125, M-1552)?
2. Is there a difference in the apoplastic fluid of infected plants, as compared to non-infected plants?

MATERIALS AND METHODS

Sterilization and germination protocol for corn seeds was adapted from Bacon et al (1994). Corn seeds were surface sterilized and then heat sterilized prior to planting to remove microbes. The seeds used were hybrid Silver Queen, a white sweet corn variety. Seeds were washed in 200 mL of a 5% sodium hypochlorite solution for 5 minutes then washed three times in sterile deionized water and imbibed in room temperature, sterile water for 4.5 hours. The seeds were then placed in a 60°C water bath for 5 minutes then immediately rinsed in cold water to prevent embryo damage. The seeds were then planted in autoclaved Sun Gro Redi Earth potting mix in 4" square pots. Plants were grown in a growth chamber with 16 hours of daylight at 26°C and 8 hours of darkness at 20°C. Constant 70% relative humidity was maintained throughout the experimental procedure. The plants were fertilized with approximately 14 g of All Purpose Miracle-GRO mix per 3.785 liters of water (1 tablespoon per gallon) once a week and were watered daily.

Fusarium verticillioides strains were cultured on potato dextrose agar (PDA) and incubated at 25°C for 7-14 days to allow cultures to fully develop conidia for inoculation. Once incubation was complete, 5 mL of sterile distilled water was added per plate and conidia were gently dislodged with a glass spreader. The conidial suspension was then collected and placed into a 1.5 mL tube. A 50 µL aliquot of conidia suspension was inoculated into the central whorl of the corn plant and left to incubate. Plants in the control group were inoculated with a 50 µL aliquot of sterile water. The corn plants used were growing for a week prior to inoculation. A hemocytometer was used count conidia to determine how many conidia were inoculated per plant.

ENDOPHYTIC GROWTH TEST

Plants were measured for height from the base of the stem to the top of the longest leaf. Measurements were taken either before inoculation or one day after inoculation followed by measurements taken at 7, 14 and 21 days after inoculation and averaged for each experimental group, adapted from Arias et al. (2012). A total of 360 plant measurements were analyzed for this test (3 treatments × 4 measurement dates × 10 plants per sampling date × 3 repeated trials).

ENDOPHYTIC COLONIZATION TEST

Plants were dissected 17-21 days after inoculation to obtain samples from leaves that were developing during or after the inoculation (the third and/or fourth leaf). These leaf, stem and node samples were then sterilized in a 1% sodium hypochlorite solution for one minute and then immediately washed twice in sterile deionized water. The samples were then placed on PDA and incubated at 25°C for at least 72 hours to allow growth of microorganisms from the plant tissue. During the evaluation of samples, if *Fusarium verticillioides* was observed, a sample of that plate was then cultured on another plate at 25°C for at least 72 hours to further observe microbial growth.

Apoplastic Fluid Collection

Once the endophytic growth experiment was completed, a random sample of plants from each treatment was used to collect apoplastic fluid for analysis. The leaves from the plants used were either formed during or after the inoculation period. The leaf used to collect apoplastic fluid was washed immediately after being cut and placed in 35 mL of deionized water, 50mM sodium chloride (NaCl) or 100 mM sodium phosphate buffer (Na_2HPO_4) in a 60 mL syringe. A vacuum seal was then created with the syringe by removing all air and sealing the end with ParaFilm. The plunger of the syringe was then gently pulled back and forth for 2 – 2.5 minutes or until the leaves had a deep green color, which indicated fluid infiltration. At that point, the leaves were removed from the syringe and surface dried with paper towels. The leaf samples were then placed in 60 mL tubes with a 1.5 mL vial at the bottom to collect any apoplastic fluid and spun in a centrifuge at 2000 rmp (828 g) for 10 minutes at room temperature. The apoplastic fluid collected was then quantified and either prepped for an SDS-PAGE or stored with an equal volume of 30% glycerol at -20°C.

SDS-PAGE and Silver Stain

Once the apoplastic fluid from each treatment was collected and quantified, 5 µL was used for the sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE). Once placed in a separate vial, 5 µL of 2X Sample Buffer was added to the sample. The sample was then heated at 95°C for two minutes. The sample was then loaded onto a 12% polyacrylamide gel (Thermo Scientific, 2013), with 2 µL of PageRuler Unstained Protein Ladder (Thermo Scientific, 2013) loaded in a separate well. The gel was run at a current of approximately 150 V for 35 – 50 minutes. Once the gel electrophoresis was completed, the silver staining process began. The gel was washed twice in 50 mL of ultrapure water before staining began. Silver staining was done according to the manufacturer protocol (Thermo Scientific Pierce Silver Stain Kit, Thermo Scientific, 2013).

Results

Endophytic Growth Test

At the completion of the first trial, the control group had the largest mean height at 87.9 cm, followed by the group inoculated with M-1552 at 86.04 cm, with the M-3125 group having the smallest mean height at 83.41 cm (Figure 2). However, the M-3125 group had the greatest mean height on Day 7 at 27.35 cm and the M-1552 group had the greatest mean height on Day 14 at 56.51 cm (Figure 2). At the completion of the second trial, the control group once again had the largest mean height at 120.21 cm, followed by the M-1552 group at 118.06 cm, with the M-3125 group having the smallest mean height at 115.04 cm (Figure 3). However, at Day 14, the M-3125 group had the greatest mean height at 85.81 cm (Figure 3). Observations of the two experimental groups inoculated

with the M-1552 and M-3125 strains of *F. verticillioides* included chlorosis of the leaves and high levels of anthocyanin in the stems and leaves (Figure 5,6)

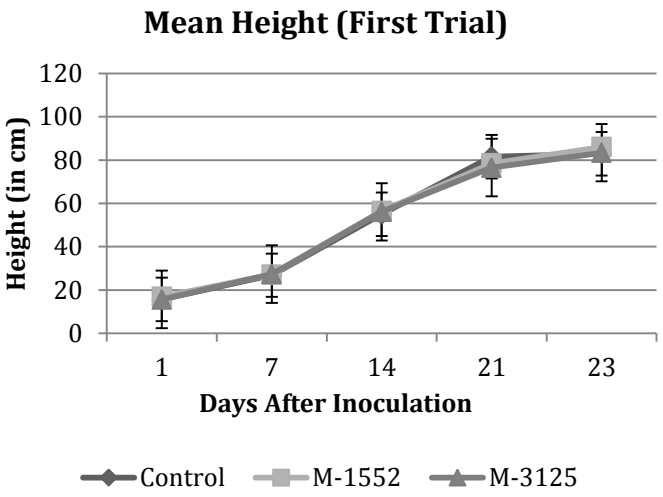
At the completion of the first and second trial of the endophytic growth test, there was no significant difference in the mean height between plants in the control group, the M-1552 group or the M-3125 group (P >0.05) (Figure 4). The mean heights of each group also did not differ significantly during the 7, 14 or 21-day intervals (P >0.05).

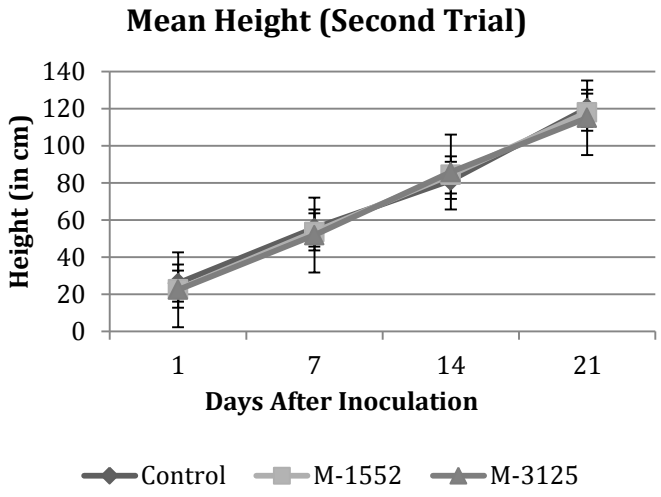
Endophytic Colonization Test

For the first and second trial, no *F. verticillioides* was observed growing from surface sterilized tissue of water inoculated plants. In both trials plants inoculated with the M-1552 isolate had *F. verticillioides* successfully re-isolated at a rate of 40% and those inoculated with the M-3125 isolate had *F. verticillioides* successfully re-isolated at a rate of 20%. Most of the *F. verticillioides* found on plates had been from leaf samples that were still in the whorl during inoculation. There were also cases when samples from all three experimental groups were contaminated with bacteria, *Aspergillus* or *Trichoderma*.

Protein Composition Analysis

Protein samples from all three experimental groups in the first trial were successfully collected using all three solvents. After completing the gel electrophoresis and silver staining process, the gel was scanned (Figure 7). In the M-1552 sample collected with water, the band that was present for the control and M-3125 group at approximately 30 kDa was slightly lower than the M-1552 band found in the same area. The control sample collected with sodium chloride did not have bands at approximately 100 kDa and 45 kDa, whereas both the M-3125 and M-1552 samples had both bands. The control sample collected with sodium phosphate buffer also had a band missing at approximately 50 kDa.





Figures 2, 3. Mean height of corn plants taken during 7 day intervals after planting for each trial. The error bars at each point indicate the standard error for each sample.

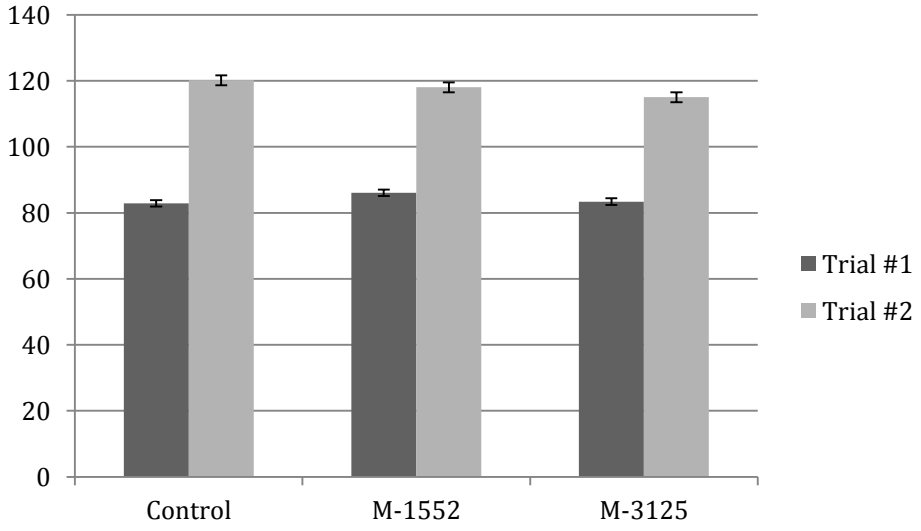


Figure 4. Mean height of each experimental group at the conclusion of data collection for each trial. The error bars on each bar indicate the standard error for each sample.

Figures 5, 6. Leaf samples collected after inoculation. Figure 5 (left) shows a sample from a plant in the control group. Figure 6 (right) shows a sample from a plant in the M-1552 group. The arrow indicates chlorosis found on the leaf, a symptom of *F. verticillioides* infection.

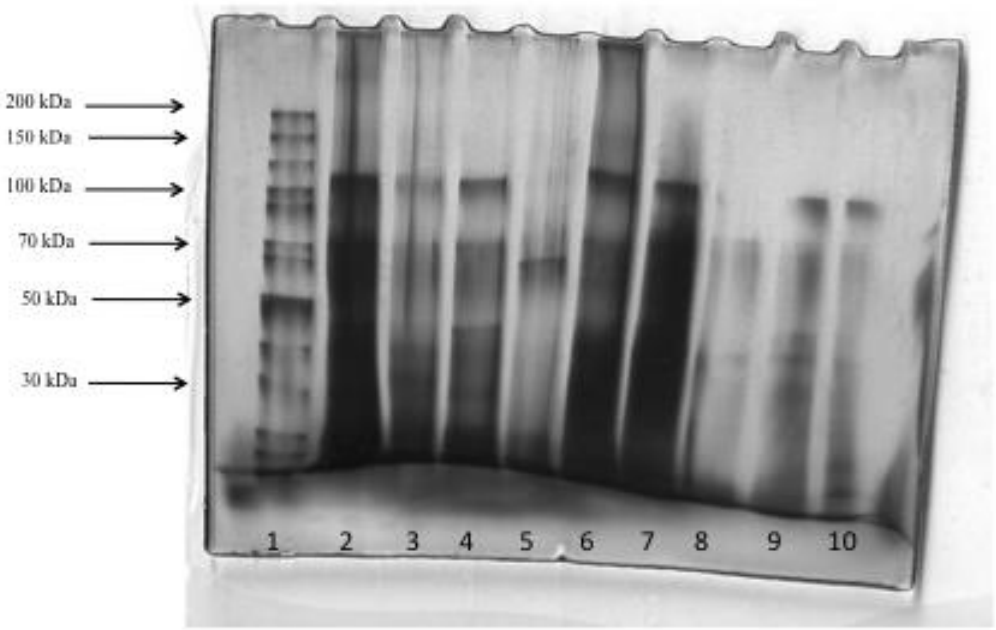


Figure 7. Silver stain gel with samples from the first trial of the endophytic growth test: Lane 1 – Molecular Weight Marker, Lane 2 – Control (Water), Lane 3 – M-3125 (Water), Lane 4 – M-1552 (Water), Lane 5 – Control (Sodium Chloride), Lane 6 – M-3125 (Sodium Chloride), Lane 7 – M-1552 (Sodium Chloride), Lane 8 – Control (Sodium Phosphate Buffer), Lane 9 – M-3125 (Sodium Phosphate Buffer), Lane 10 – M-1552 (Sodium Phosphate Buffer)

DISCUSSION

The data indicates that there is no significant difference in height between infected and non-infected plants, which correlates with the data found in the Yates study (Yates, 2004). However, physiological differences, such as chlorosis, documented in the study could become a risk in a production setting, where photosynthesis may be compromised. Future research will look to increase the sample size number, inoculate plants with a higher variety of endophytic *F. verticillioides* and increase the number of corn hybrids used.

While the hypothesis that central whorl inoculation would be successful was correct, the rate of successful re-isolation was not high. The low rate of successful re-isolation could be due to the lack of a comprehensive sampling of each plant or competition between other organisms that were competing with the *F. verticillioides* isolates. It should also be noted that *F. verticillioides* growth can be inhibited by alkaline environments and environments with high concentrations of *Trichoderma* or *Psuedomonas*, which are a noted form of biological control for *F. verticillioides* (Woloshuk, 2012; Leslie and Summerell, 2006). *Trichoderma* was found in a number of samples that were inoculated with either strain of *F. verticillioides*. Future research will look to further sterilize the potting mix used to lower the infection rate of both *Trichoderma* and bacteria while also taking more of a comprehensive sampling of plants.

While there were differences noted in the apoplastic proteins of each experimental group, the exact difference were not analyzed due to time constraints and overall quality of the protein samples. Research conducted in the Witzel study documented clearer protein bands and higher overall protein quality using the same solutions used in this study. Future research will look to use protein purification or precipitation methods to improve protein quality and quantity (Witzel, 2011). This will allow for higher quality SDS-PAGE and silver staining along with mass spectrometry to identify specific differences in apoplastic proteins between experimental groups.

The improvements in methodologies for successful isolation of apopsstic fluid will be the basis for future studies. This future research could address a number of issues that have emerged with endophytic *F. verticillioides* and corn production including unknown risks in ethanol production and phytotoxicity (Sosa, 2010) (Leslie and Summerell, 2006).

ACKNOWLEDGEMENTS

I would like to take this time to thank my faculty research advisor Dr. Gretchen Kuldau, along with the Mycotoxin Lab for their help in completing this project. I would also like to thank the department of Plant Pathology and Environmental Microbiology for providing the resources necessary to complete my research. Finally, I would like to thank the Penn State Ronald E. McNair Post-Baccalaureate Achievement Program for their funding and support throughout my research as well as my parents for their unwavering support through all of my academic endeavors.

BIBLIOGRAPHY

Arias, S. L., Theumer, M. G., Mary, V. S., Rubinstein, H. R. "Fumonisins: Probable Role as Effectors in the Complex Interaction of Susceptible and Resistant Maize Hybrids and *Fusarium verticillioides*." *Journal of Agricultural and Food Chemistry* 60.22 (2012): 5667-75.

Bacon, C. W., Bennett, R. M., Hinton, D. M., Voss, K. A. "Scanning Electron-Microscopy of *Fusarium moniliforme* within Asymptomatic Corn Kernels and Kernels Associated with Equine Leukoencephalomalacia." *Plant Disease* 76.2 (1992): 144-8.

Bacon, C.W., Hinton, D.M., Richardson, M.D. "A Corn Seedling Assay for Resistance to *Fusarium moniliforme*."*Plant Disease* 78.3 (1994): 302-5.

Bennett, J. W., and Klich, M. "Mycotoxins." *Clinical Microbiology Reviews* 16.3 (2003): 497-516.

Desjardins, A. E. *Fusarium Mycotoxins: Chemistry, Genetics and Biology*. St. Paul, Minn: APS Press, 2006.

Fandohan, P., Gnonlonflin, B. Hell, K., Marasas, W. F. O., Wingfield, M. J. "Fate of Aflatoxins and Fumonisins during the Processing of Maize into Food Products in Benin." *International Journal Of Food Microbiology* 98.3 (2005): 249-59.

Fumonisin B1. Publication. IARC, 1992. Web. 24 June 2013. <http://monographs.iarc.fr/ENG/Monographs/vol82/mono82-7B.pdf>.

"Guidance for Industry: Fumonisin Levels in Human Foods and Animal Feeds; Final Guidance." *U.S. Food and Drug Administration*. U.S. Department of Health and Human Services, 9 Nov. 2011. Web. 12 June 2013. <http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ChemicalContaminantsMetalsNaturalToxinsPesticides/ucm109231.htm>.

Hammerschmidt, R. "The Dynamic Apoplast." *Physiological and Molecular Plant Pathology* 74.3 (2010): 199-200.

Leslie, J., Summerell, B. A., Bullock, S. *The Fusarium Laboratory Manual*. Hoboken: John Wiley & Sons, Inc, 2008. 457-75.

Marasas, W. F. O., Riley, R. T., Hendricks, K. A., Stevens, V. L., Sadler, T. W., Waes, J. G., Missmer, S. A., Cabrera, J., Torres, O., Gelderblom, W. C. A., Alegood, J., Martínez, C., Maddox, J., Miller, J. D., Starr, L., Sullards, M. C., Roman, A. V., Voss, K. A., Wang, E., Merrill Jr, A. H. "Fumonisins Disrupt Sphingolipid Metabolism, Folate Transport, and Neural Tube Development in Embryo Culture and in Vivo: A Potential Risk Factor for Human Neural Tube Defects among Populations Consuming Fumonisin-Contaminated Maize." *The Journal of Nutrition* 134.4 (2004): 711-6.

Marasas, W. F. O. "Fumonisins - History, Worldwide Occurrence and Impact." *Abstracts Of Papers Of The American Chemical Society* 209 (1996): 56-AGFD.

Munkvold, G. P., McGee, D. C., Carlton, W. M. "Importance of Different Pathways for Maize Kernel Infection by *Fusarium moniliforme*." *Phytopathology* 87.2 (1997): 209-17.

Rheeder, J. P., Marasas, W. F. O., Vismer, H. W. "Production of Fumonisin Analogs by Fusarium Species." *Applied and Environmental Microbiology* 68.5 (2002): 2101-5.

Schmale III, D. G., Munkvold, G. P. "Mycotoxins in Crops: A Threat to Human and Domestic Animal Health." *Mycotoxins in Crops*. The American Phytopathological Society, 2013. Web. 12 June 2013. <http://www.apsnet.org/edcenter/intropp/topics/Mycotoxins/Pages/default.aspx>.

Sosa, M.A., Chovau, S., Van der Bruggen, B., Espinosa, J. "Ethanol Production from Corn Contaminated with Fumonisins: A Preliminary Economic Analysis Including Novel Processing Alternatives." *Industrial & Engineering Chemistry Research* 52.22 (2013): 7504-13. Print.

van der Westhuizen, L., Shephard, G. S., Scussel, V. M., Costa, L. L. F., Vismer, H. F., Rheeder, J. P., Marasas, W. F. O. "Fumonisin Contamination and Fusarium Incidence in Corn from Santa Catarina, Brazil." *Journal of Agricultural and Food Chemistry* 51.18 (2003): 5574-8.

Voss, K. A., Smith, G. W., Haschek, W. M. "Fumonisins: Toxicokinetics, Mechanism of Action and Toxicity." *Animal Feed Science and Technology* 137.3 (2007): 299-325.

Witzel, K., Shahzad, M., Matros, A., Mock, H. P., Mühling, K. H. "Comparative Evaluation of Extraction Methods for Apoplastic Proteins from Maize Leaves." *Plant Methods* 7.1 (2011): 48-.

Woloshuk, C. P., Shim, W. B. "Aflatoxins, Fumonisins, and Trichothecenes: A Convergence of Knowledge." *FEMS Microbiology Reviews* 37.1 (2013): 94-109.

Yates, I. E., Bacon, C. W., Hinton, D. M. "Effects of Endophytic Infection by *Fusarium moniliforme* on Corn Growth and Cellular Morphology." *Plant Disease* 81.7 (1997): 723-8.

Zitomer, Nicholas C. "Mycotoxicology to Accompany Phylogenetic Revisions to the Genus Fusarium." 2006. Dissertation, pp.119-36. The Pennsylvania State University.

No Mujeres, No Money: Gender Inequality and Development in Latin America

Brooke L. Abrams, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Gretchen G. Casper, Ph.D
Professor of Political Science
Department of Political Science
The Pennsylvania State University

Abstract

Previous research on unequal distribution of asset ownership, education, and income amongst men and women in Latin America (LA) inspired studies by Gaspirini and Lustig (2011); Deere, Alvarado, and Twyman (2012); and Klasan and Lamanna (2009). However, the direct correlation between gender inequality and poverty in this region has yet to be confirmed as the force that compels such social, political, and economic equality. In this paper I argue that high levels of gender inequality, not income distribution or lack of education, are the root of high levels of poverty in many Latin American countries. I examine this correlation through a mixed methodology of a statistical analysis of all countries in LA and case studies of Brazil, Costa Rica and Honduras from 1981-2004. The data conclude that with every increment of inequality between men and women, Gross Domestic Product decreases significantly by over a million dollars. To continue eradicating poverty and implementing policies equating gender in all fields, the source of this epidemic must be acknowledged.

Introduction

Latin America is named the world's most unequal region (De Ferranti, D.M., ed. 2004). In past studies, the correlation between gender inequality and poverty in LA countries was not determined; however, scholars researched the two variables separately. Moreover, many researchers defined equality and inequality and poverty in a manner that did not fully encompass the depth of these issues. Where the relationship was researched, the scales used to measure well-being excluded important variables that are imperative when assessing educational, social, and financial development. This provides the basis for constituting my study of gender inequality and poverty. By assigning specific variables to poverty and inequality, I can determine why this relationship exists and how to begin reducing the negative effects of this correlation. This study examines all twenty Latin American countries from the years 1981 to 2004 through a mixed methodology of case studies and pre-existing data sets, from the Quality of Governance Codebook, to research the link between gender inequality and welfare conditions in both rich and poor countries. Policy implications can contribute to increasing overall GDP and its well-being to become competitive with developing and already-developed countries.

The primary variable by which I measure gender inequality is expected years of schooling and mean years of schooling (United Nations Development Program). Countries with low levels of education have been shown to affect GDP per capita, average income and costs of living. Gacel-Ávila (2012) found that the lack of development in tertiary education throughout Latin American countries hinders globalization because of low levels of social and human capital. She argues that "economic growth and social progress are increasingly dependent on the production, distribution and application of knowledge, the availability of a competitive skilled human capital, as well as a high added value service sector like education" (Gacel-Ávila 2012). Frankema's (2009) analysis similarly stated that while there has been a significant expansion of education in Latin America, primary school enrollment does not suggest substantial gains in the quality of education. Thus the question arises: why are populations of certain countries in LA experiencing low levels of education, enrollment, and mean years of schooling amongst the populations of these countries? I believe this stems from an inequality that the literature is skimming over when discussing poverty and development in Latin America. First, I review previous literature and conclude that in the presence of inequality of females relative to males within the social and political realm, low levels of GDP per capita exist. Then, I present my thesis and hypotheses, and follow up by explaining the operation of each variable and how they are analyzed. Next, I describe the data sets and explain how I analyzed them quantitatively. After the results are discussed, I outline my case studies with a template and apply that to the countries chosen for the qualitative analysis. The final section concludes those findings.

Review of the Literature

The conversation about poverty in Latin America (LA) is a controversial, yet popular, dialogue in the literature. Scholars such as Gasparini and Lustig (2011) studied patterns of inequality of income distribution in reference to economically diverse regions from 1980-2008. The authors associated market-oriented forms and unskilled labor with rising inequality in the labor market. They concluded in the early 2000s that there had been a "decrease in the earnings gap of skilled/low-skilled workers and an increase in government transfers to the poor which have become progressive" (Gasparini and Lustig 2002). Although their article highlighted that accessibility to quality services (capital) must improve in order to progress, it largely targeted income inequality amongst social classes.

Klasen and Lamanna (2009) discussed gender inequality in human capital, employment and salary, which all reduce economic growth. They argued that female education is extremely relevant in reducing fertility rates, child mortality, and promoting education generationally (Klasen & Lamanna, 2009). Their methodology includes a descriptive cross-section analysis and panel regression to compare Latin American countries to other areas in the world encountering gender inequality and low economic growth. Klasen and Lamanna concluded that despite significant declines in gender gaps in labor force participation and formal-sector employment, Latin American countries are the second to last economically growing regions above Sub-Saharan Africa (Klasen & Lamanna, 2009). Although the authors demonstrated the relevance of female labor participation and wealth when looking at Latin America's stagnant economic growth as a region, the study did not explicitly attribute gender inequality to poverty nor does it compare Latin American countries to one another.

The Brandt Commission (1980) and Braveboy-Wagner (2003) disclosed major concerns of poverty in LA as an effect of its geographic location. Their findings suggested that countries in the South are far more impoverished than countries in the North. Tanzer (2012) further considered geographic location and country prosperity by concluding that equatorial regions, such as Central/South America, accrued a lower GDP per capita and thus were far poorer than regions farther from the equator.

Researchers such as Alvarez, Aranguren, Chuchryk, and Sternback (1997) examined Latin American feminism and feminist struggles in demanding gender equality in dependent, capitalist, and patriarchal states. The authors covered origins of feminism in LA from the late 1980s in countries like Peru, Chile, Argentina, Uruguay, and Brazil. The findings gathered from this study concluded that gender inequality in each of these countries was heavily dependent on government regime type, and therefore affected the accessibility of women to capital. *Gender in Latin America* written by Chant and Craske (2003) raised disputes about whether gender inequality is lessening or simply changing in nature. Chant and Craske evaluated gender inequality through democracy, policy making, civil society, and home life. They used data sets from the United Nations since 1964 on Argentina, Bolivia, Brazil, Chile, Costa Rica, Cuba, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela. Their results additionally uncovered that Latin American women were gaining considerable equality in political participation, education, the work force, within their households, and public expression. Evidence to support the argument that women in LA are making considerable gains towards equality can rely on Lipset's (1963) discovery of the Modernization theory which uses modernization as a catalyst for sustainability in social and political development, hence producing richer countries. Therefore, countries that fail to undergo modernization processes become destitute and less suitable for economic and social reforms.

While the literature mentioned above uncovers various factors that may influence poverty in such a unique region, a common disagreement remains on the source of poverty in comparison to all other countries within LA. Moreover, a huge debate persists on the amount of progress made towards development and equality in LA. Ultimately, while scholars, such as Chant and Craske (2003), defend great amelioration among Latin American women in social, political, and economic development, their methodology stimulated questions. For example, they specifically stated that the majority of their examples and tests are derived from only four of the countries listed above, which are predominantly high-income countries. Chant and Craske also do not clarify their method of case selection, or why their sample size for countries is nineteen but the majority of their research and data are largely contracted from only four of those countries. Chant and Craske, therefore, cannot accurately make the claim that Latin American women have made gains towards equality in the areas listed above, when they do not have data to compare more underprivileged locations. Their work will be most relevant to my study because my results will demonstrate that, on the contrary, Latin America has not made considerable gains towards gender equality through social, financial, or human capital, which will explain the current, poor economic status of most Latin American countries.

Hypotheses

My research question is as follows: Is there a positive association between gender inequality and poverty based upon the accessibility to human, financial, and social capital in Latin American countries? My hypotheses are listed below:

1. Where gender inequality is or has been recently practiced, that Latin American country will experience poverty.
2. In the presence of inequality of females relative to males, women participation in the labor force and in politics will be little to non-existent.
3. Regime type in Latin American countries affects accessibility to capital.
4. Regime type in Latin American countries affects the amount of gender inequality present
5. Latin American women have not made significant gains towards equality in political participation, education, or the work force.

Data and Methodology

In order to test my hypotheses, I will use a mixed methodology of a quantitative analysis of twenty LA countries, (Cuba, Haiti, Dominican Republic, Mexico, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Brazil, Bolivia, Uruguay, Paraguay, Argentina, Chile, Peru, Venezuela, Panama, Colombia, and Ecuador) and case studies of Costa Rica, Brazil and Honduras in order to carry out my qualitative study. For my quantitative analysis, I will operationalize the independent variable of inequality with indicators from the Quality of Governance data set codebook (2011) such as women's political rights and average years of education of males and females. All of the following indicators for gender inequality have been pulled from the Cingranelli and Richards Human Rights data set and the Institute for Health Metrics and Evaluation from the University of Washington by using a cross-sectional methodology. Women's economic rights are defined as the amount of flaws pertaining to women's economic rights and government practices in enforcing laws on gender equality. It is measured on a scale of zero to three. Zero equals no economic rights under the law; one is equivalent to some economic rights under the law, however, the government does not enforce it. Two signifies that there are some economic rights under law and the government does enforce them, however, they tolerate low levels of discrimination against women. Three means all or most economic rights of women under law are enforced strictly. Women's political rights are also measured on a scale from zero to three. Zero represents no women's political rights are guaranteed, one means that political equality is guaranteed by law; however, there are great limitations where women hold 5 percent or less of government or high ranking positions. Two is defined as political equality guaranteed by law and more than 5 percent but less than 30 percent hold government or high ranking positions. Three assures that political equality is guaranteed by law and more than 30 percent of high ranking positions are held by women. Average years of education of males and females is defined as the average number of years of education of men and women 25 years of age and older (Quality of Governance Codebook, 2011).

The dependent variable, poverty, will be operationalized by indicators of the Quality of Governance data set codebook, such as investment share of GDP and GDP per capita (Quality of Governance Codebook, 2011). The following indicators for poverty have been pulled from the Gleditsch Expanded GDP and Trade data set; Heston, Summers, and Aten Penn World Table; and the Maddison data set. Expanded trade and GDP is an imputed missing data set by Gleditsch

(2002) that estimates exports of other countries based on the imports of others, substitution on the basis of reverse trade flows, and linear interpolation within and beyond time-series, and assuming trade exchange rates of zero for remaining dyads with no observed data. Total imports are represented by millions of current year US dollars as a sum of import figures of all countries. Total exports are the same. Lastly, trade is defined as the sum of imports and exports in a country. Share of investment is measured as a percentage of GDP.

In order to account for other factors that may impede with the accuracy of my results, I accounted for the following controls: al_ethinic, al_language, al_religion from the Alesina, Devleeschauwer, Easterly, Kurlat & Wacziarg data set; lp_lat_abst and lp_catho80 from the La Porta, Lópes-De-Silanes, Shleifer & Vishn data set; and wdi_urban from the World Development Indicators data set. Al_ethnic codes for ethnic fractionalization measured by using a cross-section and time-series analysis from 1979-2001. Ethnic fractionalization described by Alesina is the probability that two randomly selected individuals from a particular country will not belong to the same ethnic or linguistic group; the higher the probability, the more divided the society. Alesina is defining ethnicity as a group composed of a similar language and racial background. Al_language codes for linguistic fractionalization measured through time-series and cross-section methodology in 2001, which also represents the probability that two randomly selected people originating from a specific country will not speak the same language. The higher the probability, the more linguistically fractionalized the population. Al_religion is measured and defined exactly the same: codes for religious fractionalization that provides the probability that two randomly selected persons from a country will not belong to the same religion. The higher the probability, the greater the number of religious groups that constitute that population (Alesina et al 2003). Lp_lat_abst codes for the distance of the capital city from the equator. It is measured by taking the absolute value of the latitude divided by 90 with values between 0 and 1. Lp_catho80 codes for catholic religion as a percentage of the population of a given country. I explicitly targeted Catholicism because, according to *Democracy and Development in Latin America: Economics, Politics and Religion* by David Lehman, Catholic politics has been extremely influential on governmental practices for decades. Therefore, I thought it could significantly interfere with the enforcement of gender inequality or even impact poverty since the Catholic Church acts as such a dominant institution in Latin America. Lastly, wdi_urban represents a data set created by the World Bank and the United Nations World Urbanization Prospects that calculates the percentage of a country's population living in urban areas. Urban areas are determined by national statistical offices, which are responsible for gathering and reporting censuses on population, agriculture, commerce and industry according to the Commonwealth Act No. 591.

Results

The data that I use come from pre-existing data sets compiled by the Quality of Governance Dataset Codebook (2011). The available data cover each of the twenty countries in Latin America for the period 1981 to 2004. Table 1 presents the results for my model that examines the correlation between gender inequality and poverty in this region. The table explains the dependent variable, poverty, as logged Gross Domestic Product (GDP) per capita. To produce a normally distributed model, GDP is logged. Below logged GDP on Table 1 are the variables I use to represent gender inequality and various controls discussed in the methodology section. To understand the following coefficients in dollar format, I simply utilized an

exponential calculator online which represents GDP per capita expressed as millions of dollars (Quality of Governance, 2011).

I begin with women's political rights in Table 1 as one of the variables representing gender inequality. According to the table, women's political rights have a positive and significant effect on GDP per capita by 1.17 million dollars compared with the variable gender difference in average years of schooling (the second variable used to represent gender inequality), which shows a negative, significant association to GDP under a one percent probability of error. These results suggest that as political rights in Latin American countries increase by one unit, their GDP will also increase; and each one-unit climb in the average years of education men receive over women is associated with a decrease in GDP per capita by 1.51 million dollars. Also, ethnic and language fractionalization, operating as controls, are positively and significantly correlated with GDP per capita. These are significant below a one percent probability of error that higher levels of ethnic diversity has an effect on GDP per capita by 1.58 million dollars; and each increment of linguistic fractionalization increases GDP per capita by 2.08 million dollars.

In the same table, the association between religious fractionalization (operating as a control) and GDP per capita in Latin American countries is negative, yet significant below a one percent probability of error. Particularly, for each one-percent increase in religious fractionalization, average levels of GDP per capita in LA decrease by 1.46 million dollars. Although Table 1 reveals that religious diversity harms GDP, the data indicate that Catholicism is not the cause. When controlling for all regions in Latin America that are Catholic**,** it is not significant. Thus, in regions in Latin America where religious fractionalization is high, GDP is lower. Latin American countries farther away in latitude from the equator show increases in GDP per capita by 1.51 million dollars. More precisely, countries closer to the equator experience immense levels of destitution. This result is supported by the literature of Tazner (2012) who finds that every country close to the equator will demonstrate a GDP per capita below the world average. Furthermore, "79 percent of the world's population lives closer to the equator while 21 percent are situated on the opposite side of the earth. Albeit the majority of countries cluster around the equator, only 31 percent of the world's GDP per capita concentrates these areas. The remaining 69 percent of the world's GDP per capita derives from those countries constituting that 21 percent" (Tazner, 2012). Contrary to my findings on the geographical location of a country, the literature provided by the Brandt Commission (1980) and Braveboy-Wagner (2003) suggests countries further south experience immense social and economic disparity far more than those in the North. This is supported by many studies that countries south of the equator suffer reductions in socio-economic reforms, total exports, and profits from key products, trade, and industrialization because of exploitation from richer countries (Brandt, 1980).

The results affirm that larger populations have a positive, however, less significant effect on GDP per capita by 1.03 million dollars. Likewise, elevated levels of urbanization correlate positively to higher levels of GDP by 1.02 million dollars under a one percent probability of error. My findings are further supported by Lipset (1963). In his interpretation of the Modernization theory, he states that modernization produces well-sustained democracies. These well-sustained democracies are rooted in practices aiding its citizens to flourish in economic, educational, social, and urban development (Lipset, 1963). Moreover, Table 1 shows that as investment in these countries increase, GDP will positively correlate by approximately one

million dollars. To illustrate GDP per capita for each country, the constant from the data generated predicts that any country in the sample has roughly a value of 454.9 million dollars of GDP.

Source	SS	df	MS
Model	70.8606233	10	7.08606233
Residual	17.385878	393	.044238875
Total	88.2465013	403	.218973949

Number of obs =	404
F(10, 393) =	160.18
Prob > F =	0.0000
R-squared =	0.8030
Adj R-squared =	0.7980
Root MSE =	.21033

logglegdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ciri_wopol	.1565292	.0251636	6.22	0.000	.1070571	.2060014
al_ethnic	.4591085	.1151268	3.99	0.000	.2327672	.6854499
al_language	.7301947	.0731717	9.98	0.000	.5863378	.8740516
al_religion	-.3840709	.1167419	-3.29	0.001	-.6135877	-.1545542
lp_catho80	.0014021	.0024017	0.58	0.560	-.0033197	.0061239
lp_lat_abst	.4111115	.1887597	2.18	0.030	.0400063	.7822167
genderdiffaye	-.4053984	.0310869	-13.04	0.000	-.4665158	-.344281
logmadpop	.0315697	.0163323	1.93	0.054	-.0005399	.0636793
wdi_urban	.0203417	.0014291	14.23	0.000	.017532	.0231514
pwt_isg	.0105768	.0018936	5.59	0.000	.0068539	.0142997
_cons	6.121064	.2176521	28.12	0.000	5.693156	6.548972

Table 1

While looking at the results from Table 1 of the effect of women's political rights on GDP per capital, I surprisingly find that women's political rights do not tremendously affect GDP in Latin American countries. However, as stated in the methodology section, women's political rights can be measured from 0 to 3—0 signifying an absence of political rights and 3 indicating full enforcement and encouragement of women participation in politics.

To illuminate the effect of women's political rights on GDP per capita, Table 2 displays the breakdown of the amount of presence in women's political rights in Latin American countries. Although the data in Table 1 reveal no substantial hike in GDP from one rank of women's political rights to the next, there is a notable effect on GDP per capita when women's political rights jumps from a 0 to a 3—meaning the actual impact on GDP per capita in dollars according to Table 2 rises from 1.03 to 1.48 million dollars. Thus, a country will show a greater increase in GDP if their women's political rights went from a 0 to 3 rather than just a 0 to 1 or a 1 to 2 ranking in women's political rights.

Source	SS	df	MS
Model	70.9189722	12	5.90991435
Residual	17.3275291	391	.044315931
Total	88.2465013	403	.218973949

Number of obs =	404
F(12, 391) =	133.36
Prob > F =	0.0000
R-squared =	0.8036
Adj R-squared =	0.7976
Root MSE =	.21051

logglegdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ciri_wopol						
1	.032638	.1260023	0.26	0.796	-.2150887	.2803647
2	.1934893	.1244272	1.56	0.121	-.0511407	.4381193
3	.3925573	.1445866	2.72	0.007	.108293	.6768217

Table 2

Based upon these findings, there is a positive association between gender inequality and poverty in Latin America. As mentioned earlier, the variables I use to represent gender inequality conclude that a country with high political rights and political participation for women will be richer. Also, as gaps in average years of schooling continue to increase between males and females, countries will suffer fiscally. In reference to my thesis that this association is based upon the accessibility to human, financial, and social capital in Latin America, the results only support that this association is based upon human and financial capital. The access to human capital stems from an equal opportunity of women to attend school and complete equal years of schooling relative to their counterparts. If this occurs, the results support that GDP per capita will increase. The access to financial capital relates to a country's privilege to invest; the higher the percentage of investment in LA, the richer the country. Although my findings prove my thesis correct, they cannot answer hypotheses 2 through 4, which argue that regime type in this region affects the accessibility to certain avenues of capital and the extent to which gender inequality is enforced. The temporal coverage from years 1981 to 2004 undoubtedly confirms that Latin American women have not made significant gains towards equality in political participation and education. To accurately predict present-day progress and development, a qualitative analysis is crucial when discussing government influence, women contribution to the labor force, and policy enforcement uplifting women participation in social activities and capital.

logglegdp	Coef.	Std. Err.
ciri_wopol	.1565292	.0251636
al_ethnic	.4591085	.1151268
al_language	.7301947	.0731717
al_religion	-.3840709	.1167419
lp_catho80	.0014021	.0024017
lp_lat_abst	.4111115	.1887597
genderdiffaye	-.4053984	.0310869
logmadpop	.0315697	.0163323
wdi_urban	.0203417	.0014291
pwt_isg	.0105768	.0018936
_cons	6.121064	.2176521

logglegdp	Coef.	Robust Std. Err.
ciri_wopol	.1565292	.0158465
al_ethnic	.4591085	.0627614
al_language	.7301947	.026944
al_religion	-.3840709	.0528001
lp_catho80	.0014021	.0013663
lp_lat_abst	.4111115	.0672133
genderdiffaye	-.4053984	.017927
logmadpop	.0315697	.0069991
wdi_urban	.0203417	.0007105
pwt_isg	.0105768	.0020248
_cons	6.121064	.1173647

Table 3

Table 3 compares the numerical closeness of my robust standard errors of my variables with the original standard errors to further validate my estimates. According to Gary King and Margaret Roberts (2014), the closer your standard error estimates are to your robust standard error estimates, the higher the precision in the model. In reference to Table 3, my standard errors are fairly close to one another.

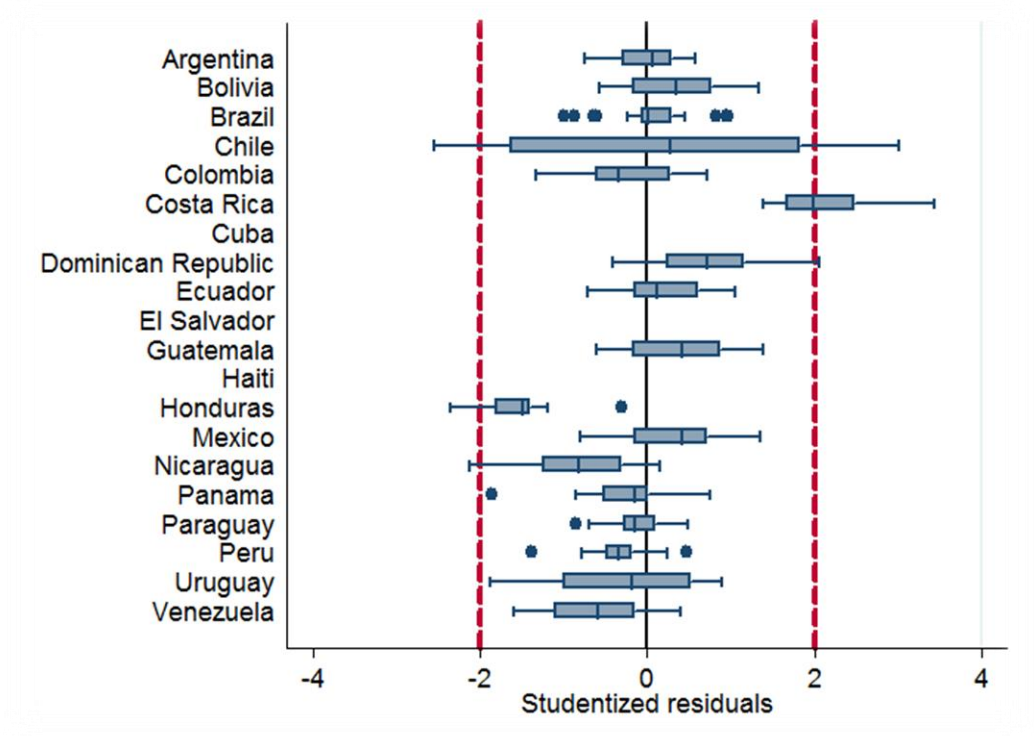
Qualitative Analysis

Case Validation

To better demonstrate the relationship between gender inequality and development, I use case studies that explore a country's social and institutional make-up in ways that numbers do

not adequately explain. The large number of cases in this region forces a case-selection of only a few countries. To determine which countries would best represent the data in the quantitative analysis, I plotted studentized residuals in figure A (below). The figure shows how well the quantitative model explains the countries in my sample. According to the case-selection criteria of Seawright and Gerring (2008), I analyze a typical case and two countries that represent extreme cases. Brazil is a typical case, in that the residuals for that country are low; this indicates that the model best explains the level of development in Brazil. A number of other countries are similarly distributed, for which the outcomes in Brazil may be generalizable. Costa Rica and Honduras represent extreme cases—the model appears to under-predict Costa Rica and over-predict Honduras. I provide a uniform template describing variables representing gender equality and poverty in order to ensure a consistent evaluation of each LA case. I represent gender equality using birth rates, the percentage of women in the labor force, the percentage of women with professional degrees, the leading sector in the labor force in which women concentrate, and presence of organizations advocating women's rights. I represent poverty with the leading sector that contributes the most towards a country's economic prosperity, industrialization, technological innovation, and growth in Gross Domestic Product (GDP) over time.

Figure A



Honduras as an Extreme Case

An extreme case exemplifies an unusual X value or standard deviation far from the mean (Seawright and Gerring, 2008). Honduras exhibits precisely an extreme case to the left of the mean of the graph, which signifies an over prediction. Relative to the rest of Latin America, roughly 75 percent of the population still lives below the poverty line. Although Honduras is a democratic state similar to the rest of Latin America (LA), one must not skip over its fairly recent democratic status just decades prior to the twenty-first century. Up until the end of the 1980s, Honduras was under extensive military rule for centuries. Since its democratic state is pretty unstable, Honduras cannot properly protect its citizens from violence. Honduras is highly corrupt and shows signs of widespread abuse of power. Furthermore, Honduras is one of the six most corrupt countries in Latin America (Wiarda & Kline, 2006). The inhabitants of Honduras live in "miserable living conditions" (Wiarda & Kline, 2006). Currently, there have been little reforms improving living standards to the underprivileged. To serve the destitute and their many disadvantageous situations, various organizations developed.

Although it was not until 1992 that a human rights commissioner began, organizations such as the Civic Council of Popular and Indigenous Organization of Honduras (COPINH), the Women's Cultural Society, the Honduran Center for Women's Studies, and the Honduran Federation of Women's Association sprung up during the 1980s and 1990s. These organizations served as advocates for the indigenous and peasant women, fought for economic and political rights, and gave legal assistance to women lobbyist (Sullivan, 2010). However the military's collegial decision-making body was not abolished until 1999. This serves as one explanation as to why I over-predicted Honduras. There is a presence of women's activist and feminist groups; however, the military still remained the strongest in power up until the late 1990s. Also, in comparison with other LA countries, Honduras' ties with the United States are rather weak. I attribute this to the strong, seemingly ever-lasting military influence in Honduras in which the United States wanted no ties. I also support my data by looking at a map of Latin America. Any map of Latin America affirms that Honduras is one of the closest countries to the equator in comparison to most LA countries. This further highlights my quantitative findings that the further south of the equator a country is, the more a country will flourish economically.

Another explanation as to why Honduras represents an extreme case is because labor unions and peasant organizations are well organized systems relative to other LA countries. This is very contradicting because, usually, benefits such as livable minimum wages, social security, and welfare are not provided to most workers. Government clinics are inefficient because of little available access to medicine and medical supplies. Systems of punishment in Honduras are split by gender, and medical care in these facilities barely exists. An education system wasn't established until the 1950s, and even then, school materials were costly. Teaching is among the worst paid professions in Honduras because of unaccredited universities, dated teacher resources and inadequate teacher training (Echeverri-Gent, 2010). If these systems and advocacy groups are well organized, why are there no gains in health and social services?

Birth rates help to explain the effectiveness of women's health care and health care in general. The higher the birth rates per 1,000 people in a population, the more poor and crowded the country. According to the World Bank Data, birth rates in Honduras began at around 43 births per 1,000 people in the 1980s. Most other LA countries during this time measured about 30 births per 1,000 people. Nearing the end of the 1990s, birth rates were still high at 33 births

per 1,000 people. It was not until 2003-2008 that birthrates dropped from 30-28 births per 1,000 people. However, as of 2012, the birth rate remains around 26 births per 1,000 people, which is roughly 11 more births higher per 1,000 people relative to most LA countries (The World Bank Data, 2014). A percentage of females in the labor force starting from fifteen years of age also indicates the equality within the workforce and a more affluent and developed country. The World Bank Data actually shows that Honduras has similar percentages of females in the labor force as Costa Rica and, in some time periods, even higher than Costa Rica whose GDP and democratic society is more developed. During the 1990s, the percentage of women participating in the labor force was around 29-32 percent. In 1999 the percentage increased to about 34 percent, and then decreased to roughly 32-33 percent from years 2003-2008. As of 2012, women participating in the labor force is approximately 34 percent (The World Bank Data, 2014). While a percentage of females are participating in the labor force, it is noteworthy to have knowledge on the leading employment sectors that contribute to a country's GDP and the percentage of women that concentrate each sector.

As in most economies in the world, the employment sector is composed of three major categories: agriculture, industry, and service sectors. In Honduras, agriculture composes roughly 14 percent of its GDP, industry about 28 percent and the service sector approximately 58 percent. More specifically, in terms of occupations of these sectors, about 39 percent of jobs are in the agriculture sector, nearly 21 percent in industry, and close to 40 percent in the service sector (Barrientos & Soria, 2014). The percentage of female employees within Honduran agriculture ranges from roughly 8 percent nearing the end of the 1990s to about 11 percent in 2011. The percentage of females employed in industry jobs ranges from up to 29 percent in the late 1990s to 21 percent in 2008 and 2011. Table 4 lists maquiladoras (factories) as the fundamental source of industry in Honduras. These factories are placed in Honduras from other countries. The placement of these factories does create jobs and benefits; however, exploitation of Hondurans may occur. Furthermore, these factories are really only creating management and assembly-line occupations, which essentially require little education and credentials. Therefore, there are not many large business owners and entrepreneurs in Honduras when compared to the average country in LA. The percentage of female employees in the service sector ranges from 69 percent in 1992 down to 65 percent in 1994 and 1995. The percentage rose to 69 percent in 2004, decreased to 63 percent in 2005, and increased to 70 percent in 2011 (Barrientos & Soria, 2014). I attribute the great fluctuation of these percentages to Hurricane Mitch in 1998 that caused five billion dollars in damage of cities. Even though the United States contributed to rebuilding, rates of inequality within the labor force, education, policy and economy imply that Honduras never fully recovered from this destruction (Wiarda & Kline, 2006). Lastly, investment as a percentage of GDP is roughly 25 percent which means 1/4 of the GDP generated is directed towards development in industry and overall development.

Overall, Honduras is suffering with higher birth and mortality rates relative to Brazil and Costa Rica. Honduras also has the lowest percentage of women in the workforce, and agriculture is the largest leading sector contributing to GDP per capita, which reflects its tremendously low GDP per capita. Moreover, Honduras is a fairly unstable democratic state in which its late abolishment of the military collegial decision-making body was just two decades prior. This also may account for why my model over-predicted this country. While it does have a presence of organizations advocating for women and is an official democracy, the extensive military

influence has undoubtedly affected the perception of women and their accessibility to existing capital in Honduras.

Costa Rica as an Extreme Case

Costa Rica (CR) exemplifies an extreme case because of its distance away from the mean cases in which my model precisely predicts. However, unlike Honduras, my model under-predicts Costa Rica-meaning that its social, economic and political development levels are higher than the average country in my sample in which my model predicts. Wiarda and Kline say, "Levels of social and economic development are higher in Costa Rica than elsewhere in Central America". The life expectancy, as of 2001, was 78 years, exceeding the expectancy of every LA country and even the United States (Wiarda & Kline, 2006). Birth rates in this country ranged from 30 per 1,000 people in the 1980s to approximately 15 per 1,000 people as of 2012 (The World Bank Data, 2014). Mortality rates in CR (the probability that a new born will die before the age of 5) range from 21 per 1,000 live births in the 1980's to 15 per 1,000 throughout the 1990s, and currently 10 per 1,000 live births (The World Bank Data, 2014). Other countries suffering crude living conditions or infringements on their human rights from the 1980s to the early 20th century neared 60 and even 100 deaths per 1,000 live births (The World Bank Data, 2014). Examples of these Latin American countries are Bolivia, Dominican Republic, Guatemala, Nicaragua, Ecuador, Peru, and Paraguay. Considering that CR is the oldest and most democratic LA country, it prides itself on rare cases of human rights violations and embodies the protection of its citizens and their civil liberties such as freedom of speech, press, and assembly along with free and open elections.

Due to its democratic ethics, CR has always dedicated policies and organizations towards advocating women equality and progression. According to the United Nations (UN) Refugee Agency, CR has an organization, Colectiva Por el Derecho a Decidir (CPDD), which advocates for preventive care for women and educates them on the rights of their own body and abortion. The National Women's Institute of CR defends women's rights and insures that its government institutes policies equating both sexes. The Women's Delegation is a cost-free assistance program serving women in CR suffering from domestic violence. They arrange protection and legal, medical and psychological aid to women as well (UN Refugee Agency, 2014). Costa Rica also passed the gender quota law (1997) to encourage and increase women representatives in the policy-making processes of the legislature. Since the passing of this law, women political participation has increased, which could explain its higher percentages of women in the labor force over countries similar to Honduras but not yet equivalent to the richer Brazil (Wiarda & Kline, 2006).

In 1993, women comprised roughly 29 percent of the labor force. Between the years 1999 and 2003, women in the labor force expanded from around 32 percent to almost 34 percent. As of 2012, the percentage of women in the labor force is a little over 36 percent (The World Bank Data, 2014). Although CR is advanced in economic and social development relative to other Latin American countries, these percentages demonstrate fairly low levels of female participation in the workforce that should otherwise correspond to its higher levels of development. Costa Rica has also avoided the harsh labor systems previously present in most Latin American countries (Wiarda & Kline, 2006).

There are three major sectors that comprise any labor force: agriculture, industry, and service sectors. The service sector is the leading sector in which women concentrate. The

percentage of women who comprise this sector ranges from roughly 73 percent in the 1980s to 85 percent in 2012 (The World Bank Data, 2014). The service sector as a composition of Costa Rica's GDP is about 72 percent, industry around 22 percent, and agriculture approximately 6 percent. The service sector also makes up roughly 64 percent of jobs in CR, industry 22 percent, and agriculture 14 percent (Barrientos & Soria, 2014). Within the labor force, there are small amounts of an indigenous presence and labor compared to other Latin American countries. As of 2010, GDP per capita for CR was an estimated $9,000, which was well above many countries in LA, including Guatemala ($4,500), Honduras ($2,500), Nicaragua ($3,600), Columbia ($7,000), Ecuador ($5,000), Peru ($5,100), Bolivia ($3,600), and Paraguay ($5,200) (Quality of Governance Codebook, 2011).

Tourism is very popular in CR: it contributes immensely to GDP (Wiarda & Kline, 2006). Under industrialization on Table 4, tourism is listed. While the tourism is not typically considered industrialization, the amount of reconstruction on roads, new hotels, and resorts for the tourist certainly accounts for investments in industry. So, as an industry, tourism is creating wealth in Costa Rica. This generated wealth could cloud the real circumstance of gender inequality. This means that it could be tourism that is accounting for its affluent state, not their high levels of gender equality. This could explain why my model under-predicted Costa Rica. Although there are high levels of development, this development may not even relate to the amount of gender equality in this country no matter the laws or government stability.

Brazil as a Typical Case

According to the model of studentized residuals, Brazil represents a typical case from the case-selection criteria of Seawright and Gerring (2008). As a typical case, relative to the outliers on that graph, Brazil demonstrates, on average, how most countries look in LA. Brazil is one of the richest countries in LA with a GDP of $11,208 per capita (World Bank Data, 2014). Although they are leading the race in affluence, they are still lagging behind in development and equality. As stated in Table 4 below, Brazil has low birth rates ranging from 32 per 1,000 in 1980 to 15 per 1,000 in 2012. Brazil also has current lower birth rates than countries like Honduras, yet higher birth rates than the less-developed CR (The World Bank Data, 2014). Why? Brazil contains crowded favelas in which they experience many droughts, unsanitary living conditions, and a concentration of impoverished people. This is the cause of extreme levels of urbanization. These areas lack clean water systems and sewer facilities (Wiarda & Kline, 2006). Additionally, diseases such as Leprosy and AIDS are most significantly affecting these mortality rates. While Brazil is the largest provider of the health maintenance organization and services compared to other LA countries, the services are low-budget and limited. Mostly affluent patients take advantage of advanced medical treatment and facilities (Tuyen, 2010). Many other countries in LA are experiencing this as well.

As a democratic state, Brazil has a large presence of organizations advocating for women's and human rights according to Table 4. They even have indigenous councils. Organizations such as Ações em Gênero Cidadania e Desenvolvimento (AGENDE) strengthen democracy through feminist perspectives on political and social reforms. It also ensures policies eradicating racial and gender inequalities. The Centro Fenimista de Estudos e Assessoria (CFEMEA) helps women work for citizenship and fight for gender equality. The Comitê Latino-americano e do Caribe para a Defesa dos Direitos da Mulher (CLADEM) is a Latin American and Caribbean Committee for the Defense of Women's Rights. Instituto Promundo promotes

gender equality attitudes and actions among youth. They also challenge traditional roles and prevent gendered violence. The Conselho Nacional dos Direitos da Mulher (CNDM) produces policies to deracinate discriminatory attitudes or actions against women. Similarly to CR, Brazil encourages political, economic, and social participation (National Resource Center on Domestic Violence, 2011). Even though Brazil does have a plethora of organizations combating existing gender inequalities, Congress, mayors, and checks and balance systems are weak (Wiarda & Kline, 2006). Therefore, this could explain why there are high amounts of gender inequality because these political-making bodies may not strictly articulate the importance of these organizations. Political appointment and government positions were within family regardless of qualifications. For example, in 2002, Lula da Silva was barely literate but won the presidency (Wiarda & Kline, 2006).

While Honduras was still living in extreme poverty and under military rule in 1988, Brazil's newly constructed constitution ensured the right to strike, vote at sixteen, abolish censorship, and gave more power to state rule (Wiarda & Kline, 2006). This could attribute to why they have a higher percentage of women in the labor force compared to CR and Honduras. In Brazil, women constitute 44 percent of the labor force; in the 1990s this percentage was about 35 (The World Bank Data, 2014). Not even two decades ago, men held 61 percent of total jobs, yet women's wages averaged 62 percent of men's wages in 1997. Though roughly 1/5 of the population lives in extreme poverty, Brazil does have a strong middle class that actually accounts for a large amount of the population (Sawyer, 2010).

Brazil is largely composed of agriculture, mining, manufacturing and service sectors. It became a net external creditor with two ratings awarded in investment grade status to debt. Agriculture, as a sector, composes 5.2 percent of Brazil's overall GDP. Industry composes about 26 percent, while the service sector composes 69 percent of GDP as of 2012 (Barrientos & Soria, 2014). By occupation, agriculture composes roughly 16 percent of the labor force, industry about 13 percent, and services around 71 percent as of 2011. The percentage of female employees in agriculture ranged from 20 percent in 1981 to 11 percent in 2011. Women accounted for up to 14 percent of employees in the industry sector in the 1980s and, in 2011, roughly 12 percent. Currently, females account for 77 percent of the employees in the service sector. Although Brazil has experienced high levels of industrialization, especially in its hydroelectric power plant, there was a low supply and even a blackout in April of 1997 (Mueller & Baer, 2010). Even as the world's largest hydroelectric plant, the production of energy is very costly and inefficiently managed (Wiarda & Kline, 2006).

Overall, Brazil is competitive when considering GDP per capita; however, there are many improvements this country must undergo to thrive in development. Brazil also still faces high unsanitary living conditions and uncleanly drinking water. Urbanization is actually hindering Brazil because of its large population and over-crowded cities. While Brazil is receiving exposure for hosting and winning world-wide competitive events such as the World Cup, it faces problems with these earnings and even other entrepreneurs failing to contribute some of their wealth to improve the quality of Brazilian life (Wiarda and Kline, 2006). Brazil, then, illustrates a typical case because, while it is wealthy, it lacks key development in daily living and female progression like most other countries in this region.

Case Study Template of Variables

Country	Birth rates	Mortality rates	Presence of orgs. advocating women's rights	% of women in the labor force	Leading sector in labor force that women occupy	Largest leading sector of labor force contributing to GDP	Industrialization	GDP per capita
Honduras	26 per 1,000	23 per 1,000	yes	34%	Service	Agriculture	Maquiladoras (factories)	$2,291
Costa Rica	15 per 1,000	10 per 1,000	yes	36%	Service	Service	Tourism	$10,185
Brazil	15 per 1,000	14 per 1,000	yes	44%	Service	Service	Hydroelectric power	$11,208

Table 4

Conclusion

This article focused on an aspect of the literature that fails to accurately examine the origins of poverty in Latin America—gender inequality amongst women. Prior research has largely addressed the roots of poverty stemming from Latin America's inability to close its income gap amongst class stratification, establish adequate educational facilities, and change mentalities of traditional roles and women's accessibility to asset ownership. This article has argued that poverty stems from a different type of inequality that will then affect the other areas of inequality just mentioned. The thesis of the article stated is that there is a positive correlation between gender inequality and poverty in LA. I hypothesized that the level of gender inequality in any given country in LA relies on women's accessibility to human, financial, and social capital. I also hypothesized that regime type in each country will shape perceptions of women and their accessibility to the types of capital mentioned. To test these predictions, I drew data and variables from the Quality of Governance Codebook (2011) that represent gender inequality, poverty, and any controls in this study. STATA (statistical software) then analyzed these variables together to form the given results. Although missing data from the variable representing poverty and one of the controls constricted my temporal coverage to 1981 to 2004, the results supported my claim of a positive correlation between the independent and dependent

variable. To further analyze this relationship, I conducted case studies found on the studentized residual graph that illustrated two extreme outliers in which I further examined poverty in conditions unpredicted by my model. I created a template consisting of new variables from the International Labor Organization, Index Mundi, and the World Bank that I gathered to represent poverty and gender inequality. I then applied these variables for the two extreme cases (Honduras and Costa Rica) and a typical case (Brazil) in a context that might explain the over-development and under-development unaccounted for in the quantitative analysis.

This article has contributed to poverty and development in LA by proposing a different perception of how previous literature describes inequality and development. The temporal coverage lends significant insight to various time periods and political and economic activity from one decade to the next. It shows that, while previous research has been conducted to tackle this epidemic of poverty and development in LA, there is another correlation that serves to explain an origin not thoroughly studied. The results from the quantitative analysis shed light on the direction and significance of the correlation of the two variables. The findings also support that excluding women from the labor force and women political participation have colossal effects on Gross Domestic Product per capita by over one million dollars with every one unit increase. Religious fractionalization in LA actually decreases GDP per capita. This could add an additional reason as to why some countries are poor in this region since the widely-known belief is that Catholicism mostly constitutes this region. The quantitative results could neither support any hypotheses on the effects of regime-type influences on women equality nor add substance to explain Costa Rica and Honduras as extreme outliers and Brazil as a typical case in LA. The case studies, however, serve to answer these hypotheses and give background information to the new variables stated in the template. The case studies' findings, Honduras and Costa Rica particularly, depict that regime type certainly shapes a country's attitudes of women's rights and wealth. Moreover, the stability of the government type affects the extent of enforcement of gender inequality in these countries.

While the findings from the case studies in this article report that industrialization is imperative to increase the wealth of each country, it can actually restrict development if the main source of industry actually assists other countries more than itself, like in the case of the maquiladoras in Honduras. The case studies also clarify that while industrialization in a country can cause wealth, it does not necessarily mean that this wealth is attributed to high levels of gender equality. As exemplified in the case of Costa Rica, tourism contributes largely to the industrialization, which then produces one of the highest GDP per capita in LA; therefore, it could cloud the actual effects of gender inequality on GDP per capita in this country.

In conclusion, this article supports the existing literature that inequalities in LA are driving poverty; however, the inequality described in this article develops a new outlook on the origin of poverty in this region. As a result of this newfound correlation, a contemporary approach of eradicating gender-related inequalities can be applied to tackle other inequalities in previous literature that domino after gender inequality. To create a more accurate, present-day illustration of poverty in LA, data sets with more extensive temporal coverage can be analyzed. Other measures of gender inequality, such as the percentage of females who completed tertiary education and the fields in which their degrees are received, can be assessed to obtain information on the types of positions they are appointed to after their education. These measures

could reveal how a woman's degree in LA is valued, and if the labor force allows women to secure employment and wages respective to that degree.

References

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., and Wacziarg. R. (2003). Ethnic Fractionalization. *Quality of Governance Dataset Codebook.* Retrieved from http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/fractionalization.xls

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., and Wacziarg. (2003). Religious Fractionalization. *Quality of Governance Dataset Codebook*. Retrieved from http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/fractionalization.xls

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., and Wacziarg. (2003). Linguistic Fractionalization. *Quality of Governance Dataset Codebook.* Retrieved from http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/downloads/fractionalization.xls

Arrighi, G., Silver, B. J., & Brewer, B. D. (2003). Industrial Convergence, Globalization, and the Persistence of the North-South Divide. *Studies in Comparative International Development*, *38*(1), 3-31. doi: 10.1007/BF02686319

Barrientos M. and Soria C. (2014). *Index Mundi*. Available from http://www.indexmundi.com/facts/

Brandt, W. (1980). North-South: a program for survival: report of the Independent Commission on International Development Issues. Retrieved from http://www.popline.org/node/446780

Braveboy-Wagner (2003). *The Foreign Policies of the Global South: Rethinking conceptual frameworks.* Boulder, CA: Lynne Rienner Publishers.

Chant S. H and Craske N. (2003). *Gender in Latin America*. New Brunswick, NJ: Rutgers University Press.

Cingranelli, D. L., and Richards, D. L. (2010). Human Rights Dataset. *Quality of Governance Dataset Codebook.* Retrieved from http://www.humanrightsdata.org

De Ferranti, D. M. (Ed.). (2004). *Inequality in Latin America: Breaking with history?*. Washington, DC: World Bank Publications.

Deere, D. C., Alvarado, G. E. and Twyman, J. (2012). Gender Inequality in Asset Ownership in Latin America: Female Owners vs Household Heads. *Development and Change*, 43(2): 505–530. doi: 10.1111/j.1467-7660.2012.01764.x

Echeverri-Gent, E. (2010). The Society and Its Environment. In *Library of Congress Country Studies: Honduras* (chapter 2). Retrieved from http://lcweb2.loc.gov/frd/cs/hntoc.html

Ferreira, F., and Gignoux, J. (2008). The Measurement of Inequality of Opportunity: Theory and an application to Latin America. *World Bank Policy Research Working Paper Series*. Available at SSRN: http://ssrn.com/abstract=1155285

Frankema, E. (2009). The Expansion of Mass Education in Twentieth Century Latin America: A Global Comparative Perspective. *Revista de Historia Económica/ Journal of Iberian and Latin American Economic History*, (Second Series) 27(3): 359-396. doi:10.1017/S0212610900000811

Gacel-Ávila. (2012). Comprehensive Internationalisation in Latin America. *Higher Education Policy*, 25, 493-510. doi:10.1057/hep.2012.9

Gakidou, E. et al. (2010). Institute for Health Metrics and Evaluation. *Quality of Governance Dataset Codebook*. Retrieved from http://www.healthmetricsandevaluation.org/

Gasparini, L., & Lustig, N. (2011). The rise and fall of income inequality in Latin America. *The Oxford Handbook of Latin American Economics*, 691-714. Retrieved from http://www.ecineq.org/milano/WP/ECINEQ2011-213.pdf

Gleditsch, K. S. (2002). Expanded Trade and GDP Data. *Quality of Governance Dataset Codebook*. Retrieved from http://privatewww.essex.ac.uk/~ksg/exptradegdp.html

Heston, A., Summers, R., and Aten, B. (2009). Penn World Table. *Quality of Governance Dataset Codebook.* Retrieved from http://pwt.econ.upenn.edu/php_site/pwt_index.php

King, G. and Roberts, M. (2014). *How Robust Standard Errors Expose Methodological Problems They Do Not Fix, and What to Do About It*. Retrieved from http://gking.harvard.edu/publications/how-robust-standard-errors-expose-methodological-problems-they-do-not-fix

Klasen, S. and Lamanna, F. (2009). The Impact of Gender Inequality in Education and Employment on Economic Growth: New Evidence for a Panel of Countries. *Feminist Economics*, 15(3), 91-132. doi: 10.1080/13545700902893106

La Porta, R., López-de-Silanes, F., Shleifer, A., and Vishny, R. (1999). Latitude. *Quality of Governance Dataset Codebook.* Retrieved from http://mba.tuck.dartmouth.edu/pages/faculty/rafael.laporta/publications/LaPorta%20PDF%20Papers-ALL/Quality%20of%20Govt-All/Quality%20of%20Govt.xls

La Porta, R., López-de-Silanes, F., Shleifer, A., and Vishny, R. (1999). Religion: Catholic. *Quality of Governance Dataset Codebook.* Retrieved from http://mba.tuck.dartmouth.edu/pages/faculty/rafael.laporta/publications/LaPorta%20PDF%20Papers-ALL/Quality%20of%20Govt-All/Quality%20of%20Govt.xls

Lehman, D. (1990). *Democracy and Development in Latin America: Economics, politics and religion in the post-war period*. Philadelphia, PA: Temple University Press.

Lipset, S. M. (1963). *Political man: The social bases of politics* Garden City, NY: Doubleday.

Maddison, A. (2003). Population. *Quality of Governance Dataset Codebook*. Retrieved from http://www.ggdc.net/maddison/

Mueller, C. C and Baer, M. (2010). The Economy. In *Library of Congress Country Studies: Brazil* (chapter 3). Retrieved from http://lcweb2.loc.gov/frd/cs/brtoc.html

National Resource Center on Domestic Violence. (2011). *Working to end violence against women in brazil*. Retrieved from http://www.vawnet.org/special-collections/Brazil.php

Quality of Governance Dataset Codebook. (2011). University of Gothenburg: The Quality of Government Institute. Retrieved from http://www.qog.pol.gu.se

Sawyer, D. R. (2010). The Society and Its Environment. In *Library of Congress Country Studies: Brazil* (chapter 2). Retrieved from http://lcweb2.loc.gov/frd/cs/brtoc.html

Seawright, J., & Gerring, J. (2008). Case Selection Techniques in Case Study Research A Menu of Qualitative and Quantitative Options. *Political Research Quarterly*, *61*(2), 294-308.

Sternbach S. N., Navarro-Aranguren M., Chuchryk P. and Alvarez S. E. (1997). Feminisms in Latin America: From Bogotá to San Bernardo. *Chicago Journal*, 17(2), 393-434. http://www.jstor.org/stable/3174469

Sullivan, M. P. (2010). Government and Politics. In *Library of Congress Country Studies: Honduras* (chapter 4). Retrieved from http://lcweb2.loc.gov/frd/cs/hntoc.html

Tazner, S. (2012). Why Is There Such a Strong Correlation Between Geographic Distance from the Equator and Prosperity?. *Quora Contributor*. Retrieved from http://www.forbes.com/sites/quora/2012/03/20/why-is-there-such-a-strong-correlation-between-geographic-distance-from-the-equator-and-prosperity/

Tuyen, J. M. (2010). Health Status and Health Care. In *Library of Congress Country Studies: Brazil* (chapter 2). Retrieved from http://lcweb2.loc.gov/frd/cs/brtoc.html

United Nations High Comissioner for Refugees. (2014). *The UN refugee agency.* Available at: http://www.unhcr.org/cgi-bin/texis/vtx/home

Wiarda, H. J., & Kline, H. F. (2006). *Latin American politics and development*. Boulder, CO: Westview Press, 6th edition.

World Bank Open Data. (2014). *The World Bank Group*. Available from http://data.worldbank.org/

World Bank Open Data. (2014). World Development Indicators. *Quality of Governance Dataset Codebook*. Retrieved from http://data.worldbank.org/data-catalog

Characterizing the Regulation of tfoX *in* Vibrio fischeri

Haikel N. Bogale, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Tim Miyashiro, Ph.D.
Assistant Professor
Department of Biochemistry and Molecular Biology
Center for Systems Genomics
The Pennsylvania State University

Abstract

Natural transformation describes how some bacteria can incorporate exogenous DNA into their genome and acquire new traits. This phenomenon occurs in *Vibrios* and is induced by the biopolymer chitin. In *Vibrios*, TfoX is a primary regulator of natural transformation. The mechanisms underlying chitin-induced natural transformation and activation of TfoX in *Vibrio fischeri* remain unclear. This project examines the response of *tfoX* expression to various genetic factors and environmental signals, such as *N*-acetyl-glucosamine, which is derived from chitin. The findings from this study will help us construct a model for the regulatory pathway of *tfoX* in *Vibrio fischeri*.

Introduction

Unicellular organisms greatly outnumber multicellular organisms. This could be credited to the ability of certain microbes to adapt and transform to their environment at a remarkable rate. Some microbes are able to incorporate DNA from their surroundings into their genome. This phenomenon is called natural transformation and contributes to the emergence of new traits and characteristics within the bacterium that is competent or able take in DNA material (Sun et al 2013).

Recent studies have shown that species of the genus *Vibrio* exercise natural transformation. The *Vibrionaceae* family consists of numerous Gram-negative bacteria that mostly reside in aquatic environments. Some Vibrios specifically interact with their respective multicellular host. Competence and natural transformation could be vital in these host-microbe interactions. *Vibrio cholerae*, the causative agent of the cholera disease, is predicted to competently attain genetic elements pertaining to interactions with its host from neighboring cells (Sun et al 2013). The pathogenic bacterium has garnered attention from biomedical researchers due to its impact on human health.

In addition to *Vibrio cholerae*, other Vibrios including *Vibrio fischeri* have demonstrated natural transformation (Pollack-Berti et al 2010). Despite being ancestrally related to *V. cholerae*, *V. fischeri* is a non-pathogenic bacteria that leads a symbiotic relationship with the Hawaiian bobtail squid, *Euprymna scolopes* (Verma et al 2013). With regards to natural transformation, the rate of transformation is much lower in *V. fischeri* than that of *V. cholerae*. The reason for the difference in the transforming ability between the two Vibrios remains unclear. Regardless of this difference, much of the components needed for natural transformation are conserved in Vibrios.

Previous work has shown that the biopolymer chitin appears to be a factor in the Vibrios' natural transformation process. Chitin, a biopolymer composed on β1,4-linked *N*-acetyl-glucosamine monomers, is a constituent of exoskeletons of crustaceans and the cell wall of fungi. Vibrios have been shown to thrive in environments in which chitin is abundant such as surfaces of copepods (Dalia et al 2013). Vibrios are able to use chitin as carbon and nitrogen source. Several marine Vibrios are even able to utilize carbon as a sole carbon source (Meibom et al 2003). The monomer of chitin, *N*-acetylglucosamine (GlcNAc) is a preferred carbon source that Vibrios are able to process. Hence, they have evolved to acquire GlcNAc utilization genes that are needed for the uptake and metabolism of GlcNAc. NagE, encoded by *nagE,* transports and phosphorylates GlcNAc (GlcNAc-6P). The *nagBAC* genes encode for proteins that break down the GlcNAc (Miyashiro et al 2011).

In the absence of GlcNAc, Vibrios, as well as other γ-proteobacteria, use the transcriptional repressor NagC to inhibit expression of the *nag* locus (Miyashiro et al 2011). NagC binds to two distinct sites of the *nagE* and *nagBAC* operons to inhibit transcription. This repression is alleviated by the allosteric binding of GlcNAc-6P to NagC. Activation of the *nag* genes leads to the processing of the GlcNAc as a nutrient source.

In addition to serving as a nutrient source, chitin also induces competency by transcriptionally and post-transcriptionally activating the transcription factor TfoX (Yamamoto et al 2010). All sequenced *Vibrionaceae* members possess a homologue of *tfoX* (Pollack-Berti et al 2010). TfoX activates genes that encode for the competence machinery.

Preliminary findings of this study revealed that NagC also binds and represses *tfoX* in *V. fischeri*. Therefore, we hypothesized that the presence of GlcNAc would lead to the activation of the GlcNAc utilization genes and *tfoX*. This hypothesis was tested using a GlcNAc dose response assay in which the expression of each gene was measured at increasing concentration of GlcNAc. We found that genes of the *nag* locus were activated by high concentrations of GlcNAc. However, *tfoX* expression did not increase at these high concentrations inferring a GlcNAc-independent regulation. Constructing a model that explains this *tfoX* regulation in *V. fischeri* will help us understand natural transformation better in Vibrios.

Results

GFP used to follow gene expression

The expression of the different genes was followed via reporter plasmids containing transcriptional fusions of specific promoters with *gfp*, which encodes green fluorescent protein (GFP). A gene encoding for a red fluorescent protein, mCherry, is transcribed from a constitutively expressed promoter also contained in the reporter plasmid. This serves as a control as levels of mCherry expression should be similar for all samples.

GlcNAc dose response assay

The genes *nagA, nagB, nagE,* and *tfoX* were subjected to increasing concentrations of GlcNAc to determine their corresponding responses (fig 1). The concentrations ranging from 0.01mM to 100mM were sufficient to compare expression of the genes under study. Each plot represents the effect of GlcNAc concentrations 0.01, 0.1, 1, 10, 100 mM has on the represented gene. Overall the results show that the expression of *nagA* and *nagB* was noticeably affected by increasing the concentration of GlcNAc. At higher concentrations of GlcNAc, the expression of these genes increased by about a ten-fold. For *nagE,* expression increased at 1mM and doubled to about two-fold at 10mM. In contrast, the expression of *tfoX* does not change as the concentration of GlcNAc is increased. This leads us to believe that another regulator specific to *tfoX* might be the cause of this anomaly.

GlcNAc dose-response curves for the four genes in WT

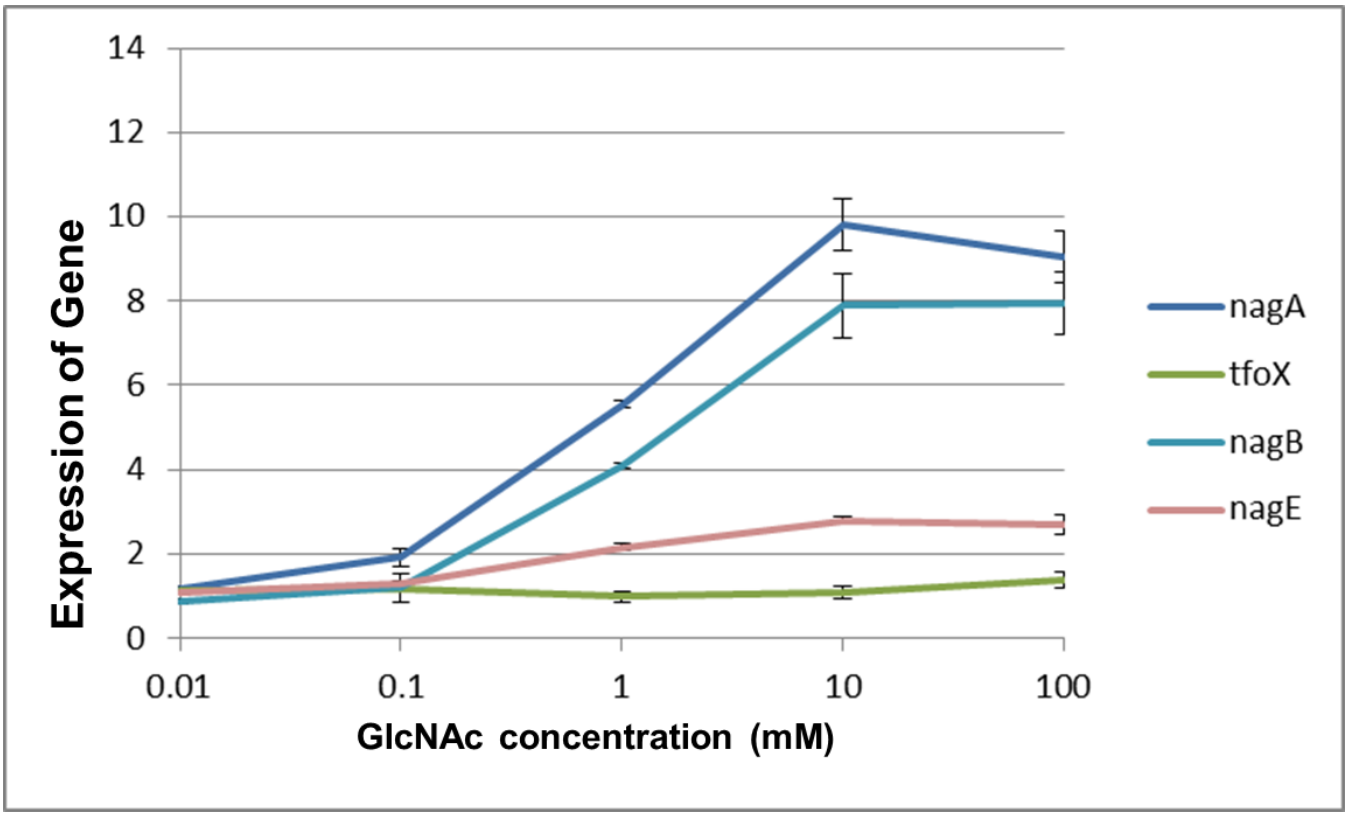


Figure 1: Expression for WT strains for four different promoters over increasing GlcNAc conc.

After seeing that *tfoX* expression was not activated by the increasing GlcNAc concentration, we wanted to test if the repression would be alleviated if NagC was removed and GlcNAc concentration was increased. Figure 2 shows that the response for *tfoX* expression in the *nagC* mutant (Δ*nagC*/*tfoX*), does not change when GlcNAc concentration is increased to 100mM. This indicates that the possible unknown regulator of *tfoX* is independent of GlcNAc levels.

GlcNAc dose response for *tfoX* WT and ΔnagC

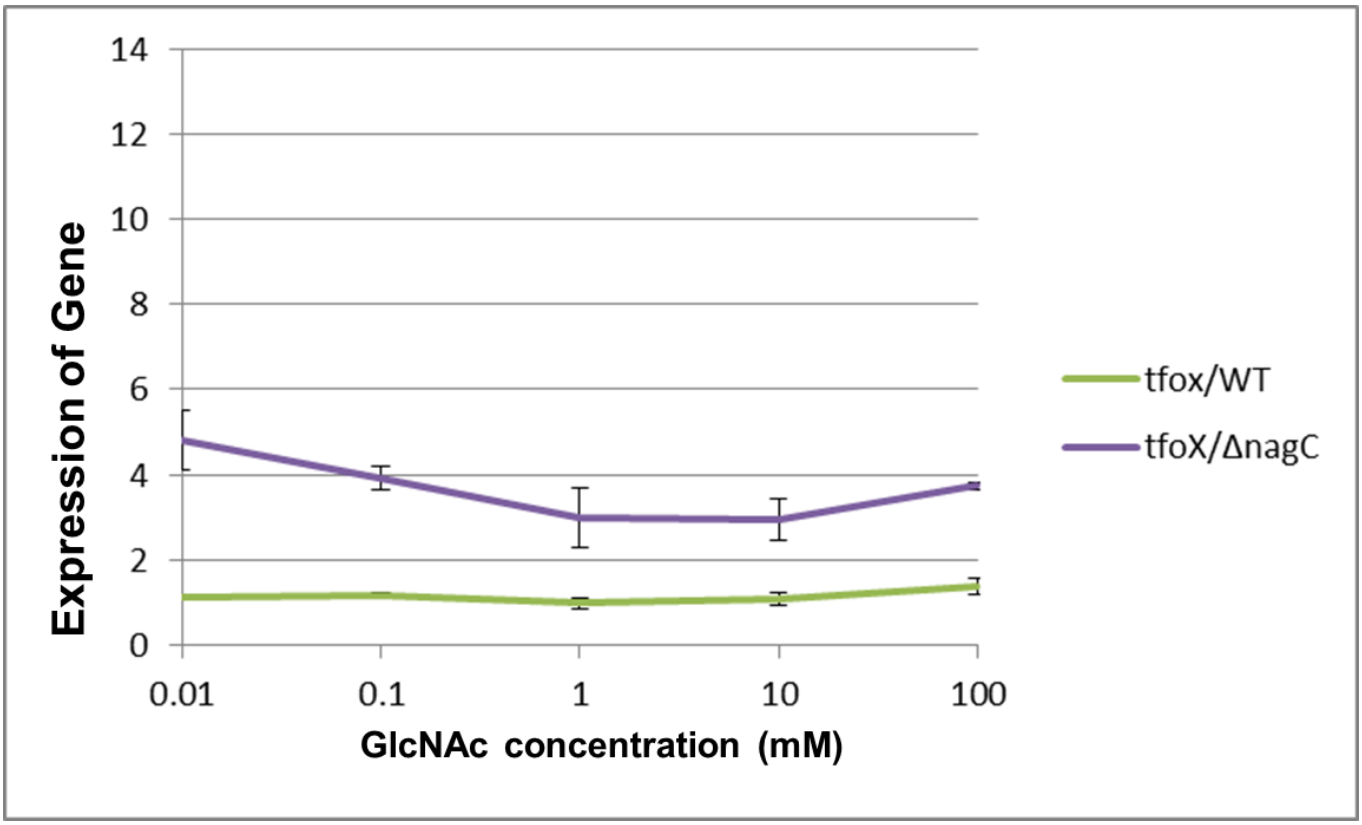


Figure 2: Expression of *tfoX* in WT and the *nagC* mutant for increasing GlcNAc concentration

Discussion

The present study was performed in order to characterize the regulatory network of *tfoX*. The fusion of the color reporter, GFP, with the promoters of *tfoX* and the GlcNAc utilization genes allowed for the monitoring of the genes' response to different concentrations of GlcNAc. Surprisingly, *tfoX* is not activated by the presence of GlcNAc like demonstrated for *nagA*, *nagE*, and *nagB*. This indicates that there could be another regulator for *tfoX* that is repressing it. We predict that this regulator is independent of GlcNAc. One possibility is that the binding pocket of GlcNAc-6P on NagC is blocked due to the dimerization of NagC. This could lead to the lack of activation of *tfoX* by GlcNAc. However, recent experiments have demonstrated that the media that *V. fischeri* cells are grown in might be the reason activation is not apparent for *tfoX* when GlcNAc is present. The latest experiment showed that induction of *tfoX* by GlcNAc is achieved

when the cultures are grown in minimal media. This indicates that the repression of *tfoX* demonstrated in the dose response curves above is due to a factor present in the LBS media. This media is a complex media with components that are not defined. I plan on doing dose response experiments with the minimal media to test if *tfoX* is activated by higher concentrations of GlcNAc, supporting the GlcNAc-NagC regulation model.

Methodology

Growth media

V. fischeri cultures are grown on LBS media at 28°C with 2.5 µg/mL chloramphenicol (CAM). CAM is the antibiotic needed so the plasmid is retained. When inoculating strain into liquid media, one micro liter is used per one mL of media.

Dose-response fluorescence assay

Cultures are grown overnight in the liquid media and antibiotic for the fluorescence experiment the next day. Before diluting overnight cultures, falcon tubes with the different concentrations of GlcNAc are prepared. From a 0.5M GlcNAc stock, GlcNAc concentrations of 0.01, 0.1, 1, 10, 100mM are prepared in a conical tube containing 10 ml of LBS+CAM. 2 ml of each concentration is dispensed into three falcon tubes for biological replicates.

Dilution of overnight cultures is 1:100. 20 µl of the overnight culture is introduced to 2ml media of each falcon tube. Afterwards, the diluted cultures are grown to optical density (O.D.) of 1. When cultures reach O.D. ~1, they are placed in an ice bucket to stop their growth. 1 ml from each falcon tube is transferred to a 1.5 ml centrifuge tube. The centrifuge tubes are spun at 15000 rpm, 4 degree Celsius for 5 minutes. The supernatant is then discarded and the pellets resuspended in 350 µl of Tris minimal media.

A plate reader is used to measure the fluorescence of cells resuspended in the minimal media. 100 µl from each centrifuge tube is transferred three times to three wells of a 96-well plate. These represent technical replicates.

References

1) Miyashiro, Tim, Will Klein, Dane Oehlert, Xiaodan Cao, Julia Schwartzman, and Edward G. Ruby. "The N-acetyl-d-glucosamine Repressor NagC of Vibrio Fischeri Facilitates Colonization of Euprymna Scolopes." Molecular Microbiology 82.4 (2011): 894-903. Web.

2) Sun, Yan, Eryn E. Bernardy, Brian K. Hammer, and Tim Miyashiro. "Competence and Natural Transformation in Vibrios." Molecular Microbiology 89.4 (2013): 583-95. Web.

3) Dalia, Ankur B., David W. Lazinski, and Andrew Camili. "Identification of a Membrane-Bound Transcriptional Regulator That Links Chitin and Natural Competence in Vibrio Cholerae." American Society of Microbiology 5.1 (2014): n. pag. MBio. Web.

4) Meibom, K. L. "The Vibrio Cholerae Chitin Utilization Program." Proceedings of the National Academy of Sciences 101.8 (2004): 2524-529. Web.

5) Yamamoto, S., H. Izumiya, J. Mitobe, M. Morita, E. Arakawa, M. Ohnishi, and H. Watanabe. "Identification of a Chitin-Induced Small RNA That Regulates Translation of the TfoX Gene, Encoding a Positive Regulator of Natural Competence in Vibrio Cholerae." Journal of Bacteriology 193.8 (2011): 1953-965. Web.

6) Pollack-Berti, Amber, Michael S. Wollenberg, and Edward G. Ruby. "Natural Transformation of Vibrio Fischeri Requires TfoX and TfoY." Environmental Microbiology (2010): n. page. Web.

7) Verma, Subhash C., and Tim Miyashiro. "Quorum Sensing in the Squid-Vibrio Symbiosis." Molecular Sciences (2013): n. pag. Print

Risky Business: Young Adults' Sexual Attitudes and their Impact on Intervention Effectiveness

Taryn Codner, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
H. Harrington Cleveland, Ph.D, J.D.
Associate Professor of Human Development and Family Studies
Department of Human Development and Family Studies
College of Health and Human Development
The Pennsylvania State University

Abstract
Sexually transmitted infections (STIs) disproportionately affect youth under the age of twenty-five. This study will identify how certain sexual attitudes held by young adults impact the effectiveness of interventions aimed at increasing safe sex. We coded these attitudes with the Sociosexual Orientation Index (SOI), and ran regression analysis of pre-survey data obtained from 321 female college students residing in Central Pennsylvania. We hypothesize that the higher the SOI, the less effective the intervention. The findings will provide information to potentially improve the design and targeting of intervention content to reduce risky sex.

Introduction

One of the most prevalent health issues facing young adults in the United States is sexually transmitted infections (STIs). STIs disproportionately affect youth between the ages of 15 and 24. These youth contract 50 percent of new STI cases (CDC, 2014). The spread of sexually transmitted infections is associated with risky sexual practices such as sex without protection, especially with multiple partners. To combat STIs, intervention programs have been developed to reduce the risky sexual behaviors. In turn, researchers have attempted to assess the effectiveness of these programs (Noar, 2008; Smoak, Scott-Sheldon, Johnson, Carey, & SHARP research team, 2006; Tanzosh, 2010). However, few studies have considered how differences between people may impact the effectiveness of these interventions. By examining the main effect of sexual attitudes on likelihood of risky sex and whether these attitudes moderate the impact of an established intervention program the present study aims to bridge this gap.

As mentioned earlier, intervention to combat youth risky sexual behaviors is an important part of combating STIs. These programs aim to educate the youth about safe sexual behaviors. Educating the youth about safe sex and the possible consequences of risky sexual behavior would help to decrease the amount of risky sexual behaviors. However, the effect intervention programs have is not necessarily equal for every individual that goes through the program. Various cultural, environmental, and biological factors influence the effectiveness of interventions. Identifying the relationship between these factors will potentially be used to improve the way safe-sex interventions are designed. My study will be examining one of these factors. Before elaborating on a particular hypothesis, I will present literature on interventions

and the sexual attitudes of the youth that affect the likelihood of engaging in risky sexual behavior.

The individual factor considered here is youth sexual attitudes. Sexual attitudes have been measured with the Sociosexual Orientation Index. Specifically, the SOI measures how willing an individual is to have sex outside of the confines of a relationship (Simpson & Gangestad, 1991). Individuals who scored higher on this scale tend to have what is known as an unrestricted sociosexual orientation. People who had an unrestricted sociosexual orientation have a higher tendency to have more sexual partners, have more one night stands and were more likely to be accepting of sexual activity outside of a committed relationship (Simpson & Gangestad, 1991). This behavior would be consistent with risky sexual behaviors as more partners would facilitate acquiring a STI. The findings of this study were replicated by a study by Penke & Asendorpf (2008). Using both the revised version of the SOI and the original SOI, individuals who were classified as unrestricted had a negative correlation to measures of attitudes toward commitment, such as staying with one partner and willingness to stay with one partner (Penke & Asendorpf, 2008). Another interesting finding revealed that unrestricted attitudes differed for men and women and between those that were and were not in a relationship. Those involved in a relationship had more restricted desires than those that were not (Penke & Asendorpf, 2008). This had more of an effect for women than it did for men (Penke & Asendorpf, 2008). Men, however, had more unrestricted attitudes when involved in a relationship (Penke & Asendorpf, 2008). This seemed to show that women's attitudes about sex seem to complement the idea of being in a committed relationship and only wanting to have sex with the person in the relationship with them. On the other hand, men seemed to be more accepting of the idea of having sex outside of a relationship and thinking about sex with other people even if they were in a relationship. This is consistent with the idea of risky sex and wanting to have sex with multiple people.

Gender influences sexual attitudes, especially when considering relationship involvement. This idea was also supported by Jackson & Kirkpatrick (2008) who found scales that correlated with the SOI (short-term mating orientation scale, long-term mating orientation scale). In this study, the short-term mating scale measured that those who were looking for mates in the short term had way more sexual encounters than those who had long-term mating strategies for both men and women. As with the previous study, men scored much higher for more sexual encounters than women when they had a short-term mating strategy.

Differences in Sociosexuality: Genetics

In addition to gender, some researchers are turning towards genetics to better understand different sexual attitudes and behaviors. From this perspective, where individuals fall on the spectrum between restricted vs. unrestricted sexual attitudes is substantially influenced by genetics (Bailey, Dunne, Kirk, Zhu, Martin, 2000). Evidence to support the importance of genetic- in contrast to family-based (i.e., shared family) influences was revealed by a study by Bailey, Dunne, Kirk, Zhu & Martin (2000). This study compared monozygotic and dizygotic male and female twins. The purpose of comparing these different types of twins was to see if genetics or shared environment made a more significant contribution to sociosexuality (Bailey, Dunne, Kirk, Zhu, Martin, 2000). In addition to genetic and shared environmental influences, which are those shared by siblings in the same household (such as parenting), these models also estimated the influence of unshared environmental influences, such as those that differ between siblings. The full model observed if genetics have an impact on the sociosexuality of men and

women. The best fitting model did not find sex differences in the etiology of sociosexuality. The findings were that the monozygotic twins had a stronger intra-pair correlation, indicating strong genetic influences and no significant shared environmental influences. In the full model, genetic influences accounted for nearly 50% of the variance in sociosexuality for both men and women, with nonshared environments accounting for the remainder. This supported that claim that genetics have a significant impact on sociosexuality variability.

Interventions to Reduce Risky Sexual Behavior

Interventions reduce the adverse consequences previously mentioned and have been proven to reduce risky sexual behavior. A meta-analysis by Noar (2008) found that interventions reduced the chance of risky sexual behavior by 28%. Additionally, the amount of sexual partners decreased by 15% in this study (Noar, 2008). Further demonstrating intervention effectiveness, condom use increased by about 34% and unprotected sex decreased by 32% (Noar, 2008).

Another meta-analysis conducted by Smoak, Scott-Sheldon, Johnson, Carey, & SHARP research team (2006) also found results that supported that interventions do make an impact. The interventions that saw an increase in the correct way to utilize a condom also saw a decrease in sexual partners and encounters (Smoak, Scott-Sheldon, Johnson, Carey, & SHARP research team, 2006).

An intervention, the Safer Sex Party, has been shown to be an effective intervention (Tanzosh, 2010). The Safer Sex Party is a peer intervention program where the educators are trained students. In the program methods of protection are covered through illustrations along with how to approach a partner about having safe sex and how risky sex can put them at risk for various infections including HIV (Tanzosh, 2010). The Safer Sex Party was found to be very effective reducing risky sexual behaviors in a study by Tanzosh (2010). Individuals who indicated that they rarely or never made use of protection before the intervention indicated that they would were either not sure, likely or very likely to use protection in the future following the intervention (Tanzosh, 2010). Additionally, the program had a positive effect on individuals who indicated that they were not thinking about being tested for HIV before the intervention. 23.4% of those who indicated that answer initially, reported that they were considering being tested after the intervention (Tanzosh, 2010).

As previous work by Smoak, Scott-Sheldon, Johnson, Carey, & SHARP research team (2006) has shown, interventions have been shown to reduce sexual risk behavior. But similar to the general prevention field, it is important to consider whom they work more for and why. As previously mentioned, sexual attitudes regarding short-term or unrestricted could affect its success. In other words, if an individual has an unrestricted or short-term mating orientation it is likely that the intervention may be effective for them but not as effective for someone who had a restricted or long-term mating strategy. This is what the present study aims to examine.

Given the previous literature, I will hypothesize that the Safer Sex intervention will be effective in reducing risky sex. As shown by Tanzosh (2010), the intervention was effective in reducing behaviors that would be considered unsafe sexual practices. Therefore, in the study, I am predicting a similar outcome.

Additionally, I predict that higher scores on the SOI will be correlated with risky sexual behavior. The previously mentioned literature found that those who scored higher had a tendency to have more sexual partners. This is correlated with unprotected sex rates. As a result, I predict these individuals will have a higher likelihood of also engaging in other risky sexual behaviors that may not be directly measured by the SOI.

Lastly, the intervention will have less of an effect on those with an unrestricted sexual attitude. Given the substantial heritability of sociosexuality (Bailey, Dunne, Kirk, Zhu, Martin, 2000), the intervention may be less successful among those individuals who show a strong genetic influence toward less restrictive sexual behavior. This is the most important hypothesis because it would imply that the individuals most at risk are not getting the same benefits that their peers who do not have the same sociosexual orientation.

Methods

Participants

The participants involved were 321 undergraduate freshman and sophomore female students at The Pennsylvania State University.

Design

The study design was a randomized pre and posttest study with groups. The subjects participated in an experiment in which sessions were split into groups that had as many as 25 individuals in one of two intervention programs: The Safer Sex Party and Stress Less. The comparison group took part in the Stress Less Intervention. This intervention was peer taught, and focused on teaching the students about the nature of stress and how to cope with it, specifically strategies for getting rid of it and ways to recognize good and bad methods of coping. The other intervention, The Safer Sex program, was also peer taught, and focused on what kinds of behaviors put them at risk for STIs, how to protect themselves, and how to approach their partners about safe sex. Information about each session and how the program ran were collected as well.

Regardless of what condition participants were in, they received a pretest and a posttest assessment. The pretest was included to see what the participants' sexual habits were like before the intervention. It also asked demographic information such as age, ethnicity/race, sexual orientation, and current relationship status. It collected information about contraceptive use, age of the beginning of puberty, and STIs. Finally, an index called the Sociosexual Orientation Inventory (SOI), which measures willingness to engage in sex inside of a relationship as well as outside of one, was included. The posttest was very much the same except for questions that were included about a high risk sexual scenario.

Procedure

Before the onset of the study, participants were made aware that the study would involve DNA collection and that they would either attend a safer sex intervention or a stress intervention. Participants could not pick which intervention in which to participate. They were made aware of this fact. Instead, participants would sign up through a given link. They would not be aware of which intervention they would be in until they arrived. The Principal Investigator would decide which sessions would be experimental and which would be control sessions before the participants were given an opportunity to sign up so that it would be more randomized. There was a minimum of two sessions a week, one that was experimental and one that was control.

Upon arrival, participants were required to check-in. They were provided with additional information about the study and given an opportunity to ask questions. After signing a consent form, they were given a pretest marked with a unique research ID number. When the participants were done filling out the pretest, the participants were given a DNA kit. This kit came with a

cotton swab and a test tube that the Principal Investigator (PI) would use to collect the DNA of the participants. These tubes had the same numbers as the participants' survey numbers. The DNA collection would follow the procedure of using cotton to do multiple cheek swabs which the PI oversaw. The cotton would then be placed in the tube and collected by the PI. The intervention program would then occur. Following the conclusion of the program, the posttest survey was completed by the participants. Participants were then debriefed and had a chance to ask any other questions they may have had. Finally, participants were compensated with a gift card from DowntownStateCollege.com.

Measures

The SOI measures willingness to have sex in and out of a relationship. Specifically, the SOI has items it measures like "overt sexual behavior". These questions cover "frequency of sex in the past month, number of lifetime partners, number of partners in the past year, number of partners desired, number of partners foreseen, and number of one night stands" (Simpson & Gangestad, 1991). Sample questions included "How many times have you had sex in the past month"?, and "With how many different partners have you had sex in your lifetime"? (Simpson & Gangestad, 1991). There is a "covert behavioral" measure which asks, "frequency of sexual thoughts, and frequency of sexual fantasy" (Simpson & Gangestad, 1991). The answers from the frequency of sexual thoughts were measured on a 9-point scale (Simpson & Gangestad, 1991). Answers ranged from 1 (virtually never) to 9 (almost all of the time) (Simpson & Gangestad, 1991).

The answers from the frequency of sexual fantasies section were measured on an 8-point scale from 1 (never) to 8 (at least once a day) (Simpson & Gangestad, 1991). "How frequently do you think about sex?" and "How often do (did) you fantasize about having sex with someone other than your current (most recent) dating partner"? would be examples from these sections (Simpson & Gangestad, 1991).

Lastly, a final section consists of attitudinal items that measure the willingness of the participants to engage in sexual activity outside the confines of a relationship. This final section was measured on a 9-point scale from 1 (strongly disagree) to 9 (strongly agree) (Simpson & Gangestad, 1991). Sample questions from here include: "Sex without love is OK", I can imagine myself being comfortable and enjoying causal sex with different partners" (Simpson & Gangestad, 1991). Individuals who scored higher on this scale tend to have what is known as an unrestricted sociosexual orientation. Scoring higher on this meant that they had a higher tendency to have more sexual partners, have more one night stands and were more likely to be accepting of sexual activity outside of a committed relationship (Simpson & Gangestad, 1991). Five SOI items were reverse-scaled for uniformity, SOI 6,7, 9,13,14. A reliability test revealed a Cronbach's Alpha of .912. This high score indicated high reliability. A scale was then created from the questions that made up the SOI.

High Risk Sex Scenario

As mentioned earlier a scenario was used in the posttest. This scenario was used to create a stimulated mood for the participants. This stimulated mood was meant to simulate the feelings a participant would encounter if they actually experienced that situation. This was to test their decision-making skills for these types of situations in real life after the intervention program.
In the scenario, a man named Michael approaches the participant at a party. Afterwards, they go out on a date and return to Michael's house. At Michael's house the pair start to kiss and things

progress until Michael announces that he does not have a condom. Participants are then asked questions about how they would react in that situation.

Analysis Framework

To test if the sex intervention was effective in reducing risky sex, linear regression analyses will be run. Linear regression will reveal if there was an association between the sex intervention and the outcome variables which were the questions related to the vignette. The sex intervention will be run with a scale that was created out of the outcome questions, MIKE1-9.

The second hypothesis, that individuals who scored higher on the SOI would have a higher tendency to engage in risky sexual behavior, will also be tested by utilizing linear regression. The scale was run against the outcome variables, the vignette questions. The same outcome scale will be used from the previous hypothesis. Additionally, a subscale will be created for the outcome variables after running a factor analysis. We will take the most significant of each component (out of 2) to create two subscales. The first subscale will be made up of MIKE 1,2,3,4,8 and the second subscale will be made of MIKE 1,2,4,5,7. These subscales will each be run against the SOI scale.

The final hypothesis that the intervention would not be as effective for participants with an unrestricted sexual attitude will also be tested with linear regression analyses. This would reveal if there was an interaction between the two. The condition, the total scale for the SOI, and an interaction variable between the two will be run against the outcome scale.

Results

The results for the first hypothesis, revealed that the Safer Sex intervention was found to be ineffective as the p-value was insignificant (p-value=.109). This means that there was no difference in responses on the outcome scale between the groups in the Safer Sex intervention and the Stress Less intervention. The intervention was not effective in reducing sexual behavior.

For the second hypothesis, the linear regression revealed a significant relationship between the SOI scale and the outcome scale (p=0.00). It had a positive correlation, (.438) meaning the higher the score on the SOI, the more likely the participant was to make riskier decisions on the outcome scale. Significant results were also found for the outcome subscales. Subscale 1 was significant with a p-value at 0.00 and correlation of .457, and Subscale 2 was also significant with p-value of 0.00 and correlation of .427.

The final linear regression tested the last hypothesis and combined the condition, the SOI, and the variable meant to measure an interaction between them. As expected given the above findings, this analysis did not find a relationship between the intervention and the outcome scale. In other words, the intervention had no impact of whether or not participants made risky decisions. There was still a significant relationship between the SOI and the total outcome scale ($p <$ 0.00). The magnitude of the associations was largely unchanged from the findings revealed in model 2 analyses above. Overall outcome association was .438, the first subscale had an association of .471, and subscale 2 had an association of .431. Most importantly for the purpose of hypothesis three, the interactions between intervention status and SOI scores were not significant (p =.958). Interaction results with both outcome subscales were also non-significant, with p-values of .776 for subscale 1 and .916 for subscale 2. These results are evidence that the intervention was no less effective for individuals with an unrestricted attitude. Even though the SOI had a significant relationship with the outcome, the fact there was no interaction between the

intervention and the SOI indicates that the scores on the SOI do not moderate the effect of the intervention.

Discussion

Only one of the three hypotheses was supported. The findings supported Hypothesis Two, that higher SOI scores would predict greater likelihood of risky sexual behaviors, as indicated by participants' responses to the scenario. The findings did not support Hypothesis One, that The Safer Sex Intervention would be effective in reducing risky sex, as participation in The Safer Sex Party vs. Stress Less was not related to risky sex likelihood. Findings also did not support Hypothesis Three, that SOI scores would moderate the effectiveness of the intervention in changing likelihood of risky sex. In terms of the findings supporting the second hypothesis, it should be noted that association between sexual attitudes and likelihood of risky sexual behaviors was quite strong (B = .438).

Impact of Findings

The impact for these findings is very important. The fact that the intervention was not effective is a huge issue. The intervention needs to be redesigned that so that it can be effective in reducing risky sexual behavior. After all, young adults need an intervention that works. When redesigning the interventions, sexual attitudes should be taken into account since it had such a strong relationship to the likelihood of risky behavior.

Limitations

There are limitations worth mentioning. First, the results may not be able to be generalized to many populations. Given the fact that most of the participants were Caucasian, these results may be more applicable to them than other groups. However, most of the Penn State campus fits that profile, so results are relevant to a large portion of Penn State students, and likely other majority ethnicity students at similar institutions. Second, the majority of the participants were heterosexual, meaning that we cannot assume these results apply to other sexual orientations. Finally, no men were included in the study. Findings from the previous studies found that men were more likely to behave or have attitudes consistent with an unrestricted orientation (Penke & Asendorpf, 2008; Jackson & Kirkpatrick, 2008). Given these findings, it is clear that risky sexual practices are not just a female issue and that men need interventions just as much, if not more than women.

Recommendations for Further Study

For further study, it may beneficial to include a diverse population of participants in terms of race/ethnicity as well as sexual orientation. This would allow us to see if the results are consistent across other groups of people. Additionally, having a follow-up survey would be a great addition to measure if the intervention made a difference in the real world instead of just through a vignette.

References

Bailey, J.M., Dunne, M.P., Kirk, K.M., Zhu, G., Martin, N.G. (2000). Do individual differences in sociosexuality represent genetic or environmentally contingent strategies? Evidence from the Australian twin registry. *Journal of Personality and Social Psychology,78*,537-545. doi: 10.1037//0022-3514.78.3.537

Centers for Disease Control (2014). Sexual Risk Behavior: HIV, STD, & Teen Pregnancy Prevention. Retrieved from http://www.cdc.gov/HealthyYouth/sexualbehaviors/

Jackson, J.J., & Kirkpatrick, L.A. (2007). The structure and measurement of human mating strategies: toward a multidimensional model of sociosexuality. *Evolution and Human Behavior*, *28*, 382-391. doi: 10.1016/j.evolhumbehav.2007.04.005

Noar, S.M. (2008). Behavioral intervention to reduce HIV-related sexual risk behavior: Review and synthesis of meta-analytic evidence. *AIDS Behavior*, *12*, 335-353. doi: 10.1007/s10461-007-9313-9

Penke, L., & Asendorpf, J.B. (2008). Beyond Global Sociosexual Orientations: A more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology*, *95*, 1113-1135. doi: 10.1037/0022-3514.95.5.1113

Simpson, J.A., Gangestad, S.W. (1991). Individual differences in sociosexuality: Evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology*, *60*, 870-883. doi: 10.1037/0022-3514.60.6.870

Smoak, N.D., Scott-Sheldon, L.A.J., Johnson, B.T., Carey, M.P., & SHARP Research Team (2006). Sexual Risk reduction interventions do not inadvertently increase the overall frequency of sexual behavior: A meta-analysis of 174 studies with 116,735 participants. *Journal of the Acquired Immunodeficiency Syndrome*, *41*, 374-384. doi: 10.1097/01.qai.0000185575.36591.fc

Tanzosh, T.N. (2010). Evaluation of a peer-led sexual health intervention administered to college students (bachelor's thesis). The Pennsylvania State University, University Park, PA.

Can Neighbors Make You Healthy? Understanding how adolescent obesity is associated with neighborhood characteristics and physical activity.

Charnice A. Culmer, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor
Lori A. Francis, Ph.D.
Associate Professor of Biobehavioral Health
Department of Biobehavioral Health
College of Health and Human Development
The Pennsylvania State University

Abstract:

Findings from several studies suggest that higher levels of neighborhood safety and social capital are associated with higher levels of physical activity, a known predictor of obesity. Presently, the obesity rate for adolescents ages 12 to19 in the United States is 16.9%, which is four times the rate noted in the 1960s. This study focuses on neighborhood characteristics, activity patterns and their association with obesity in adolescent females in the United States. Specifically, this paper examines whether neighborhood characteristics (e.g. built environment, social capital, neighborhood safety) are associated with adolescent activity patterns (e.g. weekly physical and sedentary activity) and obesity in females ages 12-17. Data were gathered using the National Survey of Children's Health, a study that focuses on health in children and adolescents 0-17 years of age in the United States. Findings will clarify the relationship between neighborhood characteristics, female adolescent activity patterns and how these variables relate to adolescent obesity.

INTRODUCTION

The recent increase in the prevalence of obesity is a great concern for the nutrition and health of the world. Many countries, including the United States, have seen an increase in obesity research to help not only understand the cause of this epidemic but treatment that can be offered. The current study explores measures of neighborhood characteristics and physical activity and their association with obesity.

"Obesity in youth aged 2-19 years can be defined as a body mass index (BMI) at or above the 95th percentile of the sex-specific Center for Disease Control BMI-for-age growth charts (Ogden et al., 2014, p.1)." Obesity in youth has risen from 6.1% from 1971 to approximately 17% in 2011 and has been steady at approximately 17% since 2003. This more than doubled increase can be seen in all major racial and ethnic groups and across the majority of developmental age cohorts (Ogden et al., 2014; Singh et al., 2008). The rise in obesity status can also have detrimental health effects for adolescents later on in life as research shows that 80% of adolescents will develop to become obese adults (CDC, 2014). Obesity in adulthood can lead to health problems such as high cholesterol, high blood pressure, cardiovascular disease, stroke and Type 2 diabetes (CDC, 2014). These progressing health conditions are sure to impact one's livelihood. For this reason, it is important to understand the causes and predicting factors of obesity.

According to Parsons and Power (1999), some predictors of obesity include dietary factors and physical activity. According to Kimm et al. (2002), since the early 1960's, the prevalence in youth obesity rates has increased dramatically, more than doubling. Research, however, has not proven that there has been "concomitant increase in food intake" thus allowing physical activity to become the focal point of study in combating the prevalence of obesity. Physical activity is a modifiable behavior that can reduce the prevalence of obesity. Research studies suggest that physical activity improves health and can work against many of the aforementioned health conditions such as cardiovascular disease, stroke and Type 2 diabetes (CDC, 2014). It is also known that current prevalence rates of obesity originate in part from declines in energy expenditure due to increasing physical inactivity (Wareham et al., 2005).

Physical activity recommendations from the Centers for Disease Control and Prevention (2014) recommend 1– 2 hours and 30 minutes of physical activity (specific recommendations depend on age) daily including aerobic activity, muscle strengthening and bone strengthening. However, less than half of adults and 10% of adolescents meet the physical activity requirements for their age group (CDC, 2014; Ding, 2011). Research also shows that physical activity decreases with age by as much as 50% (CDC, 2014; Kimm et al., 2002). Physical inactivity and sedentary activity have been found to be gender specific. A study by McMurray et al. (2000) found that girls reported less vigorous activity than boys and watched less television. A study by Boone and Gordon-Larsen (2007) examining screen time and physical activity during adolescence, found that screen time significantly influenced obesity prevalence in females. This study found that less screen time was associated with lower prevalence of obesity in females as well. A reduction in screen time and other sedentary behaviors could possibly result in more physical activity that would include play and activity outdoors in the neighborhood.

A possible predicting variable of physical activity that may also be associated with obesity would be characteristics of a neighborhood. There are many characteristics of neighborhoods including parks, the presence of amenities and resources such as stores and supermarkets, presence of sidewalks or grass, safety, etc. The relationship between neighborhood characteristics and physical activity has been researched, although few have pertained to youth (Franzini et al., 2009; Popkin, Duffey, and Gordon-Larsen, 2005). The extent to which neighborhood environments influence physical activity remains in question, especially when focusing on youth. There are many factors of neighborhood characteristics such as built environment, social capital and neighborhood safety that may help to determine levels of physical activity. Built environment is a complex concept that defines factors of the neighborhood including, but not limited to, access to resources and amenities, levels of comfort and the presence of open space for physical activity.

Built environment, a neighborhood characteristic, has been defined as a multi-dimensional concept that examines human activity of different scales in given physical environments (Popkin, Duffey, and Gordon-Larsen, 2005). Built environment includes a combination of factors such as walkability, access to recreation facilities/open space, vegetation (i.e., presence of street trees), pedestrian safety structures and social incivilities depending on the physical make-up of the neighborhood setting (Ding, 2011; Singh et al.,2010). Recently, built environment has seen changes due to increased technological use (i.e., transportation and screen time), leading to increased sedentary lifestyles of youth (Sallis et al., 2006; Popkin, Duffey and Gordon-Larsen, 2005). Youth are being driven to school more often due to distance and traveling in highly-trafficked areas. The presence of fast food restaurants and the portion sizes of food being served have also increased-- a very convenient commodity in today's society (Sallis et al., 2006). These factors of built environment are likely to be associated with fueling the current obesity epidemic.

Findings suggest that adolescents with better built environments, characterized by the presence of local markets with healthier food choices, consume less fast food; and those with better walking and playing space (i.e., sidewalks and facilities) are more likely to have better health (Sallis et al., 2006). Supporting this claim, research done by Gordon-Larsen et al. (2006) found that children that lived in urban areas of low socioeconomic class had reduced access to facilities, which therefore decreased physical activity and increased the risk of being overweight. However, a study completed by Franzini et al. in 2009 negated the association of built environment with physical activity. This study examined the association between physical and social neighborhood environments for 650 children 11-12 years of age. Previous research studies show inconsistencies in depicting the association between the neighborhood factor of built environment and physical activity (Ding, 2011; Gordon-Larsen et al., 2006; Sallis et al., 2006). Research findings, however, definitely support a correlation between built environment and physical activity. Findings, however, suggest that there is a correlation between the neighborhood characteristic of social capital and physical activity.

The neighborhood characteristic of social capital is defined as one's sense of community regarding their neighborhood or the "resources available to individuals and to society through social relationships (McNeill et al.,2006,p. 1016)". This would include dependency on one another, understanding, trust and "norms of reciprocity". McNeill et al. (2006) also defined

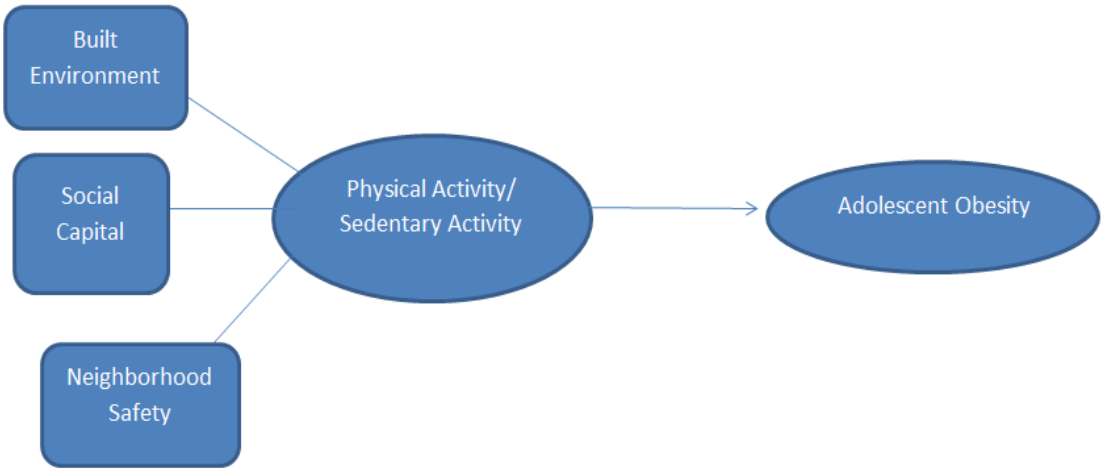
social capital as a fundamental social environmental factor that influences a multitude of health-related behaviors. Social capital has been significantly associated with risk of obesity. Specifically, lower social capital has been associated with a significantly increased risk of obesity (Singh, et al., 2008). Studies that have found an association between social capital and physical activity have also found social capital to be independently associated with low levels of obesity prevalence and, recently, with higher levels of physical activity (Singh et al., 2010; Franzini et al., 2009; McNeill et al., 2006). According to Berkman and Kawachi, as cited by McNeill et al. (2006), neighborhoods with high levels of social capital have an improved chance to reinforce good social norms that encourage positive health behaviors such as physical activity, and better and safer environments where residents could remain physically active.

Neighborhood safety is also an important neighborhood characteristic that should be considered when examining physical activity, as safety predicts physical activity (Singh, et al., 2010). Inconsistencies, however, exist in research about the association between neighborhood safety and physical activity (Davison et al., 2006). A literature review conducted by Davison et al. (2006) included nine studies that examined the relationship between perceived neighborhood safety and physical activity. Results in seven out of the nine studies reported that there were no associations between neighborhood safety and physical activity. Conversely, in 2006, Davison and Lawson et al. also found that in one of the two articles supporting a correlation between neighborhood safety and physical activity that perceived safety influenced higher self-reports of outdoor physical activity in adolescents. Research has also linked higher levels of perceived neighborhood safety with higher levels of physical activity and lower risks of obesity (Franzini et al., 2009; Singh et al., 2010). Singh et al. (2010) also found that "the odds of a child's being obese or overweight were 20-60 percent higher among children in neighborhoods with the most unfavorable social conditions such as unsafe surroundings." Some research suggests that associations between neighborhood safety and obesity are attributable to social and economic disadvantage (Ding, 2011).

The purpose of this study was to (1) examine the association between neighborhood characteristics, female adolescent activity patterns and obesity in female adolescents ages 12-17, (2) examine the relationship between neighborhood characteristics and obesity, and (3) examine the association between female adolescent activity patterns and obesity. Neighborhood characteristics were defined as built environment, social capital and neighborhood safety. The predicting factor of obesity, physical activity, was categorized with sedentary activity to define female adolescent activity patterns. This study examined how the neighborhood characteristics (i.e. built environment, social capital and neighborhood safety) were associated with female adolescent activity patterns (i.e. physical and sedentary activity) and resultantly how these variables were associated with obesity using a nationally representative sample of youth in the United States. The age range of 12-17 was chosen because it is within this stage that process of self-identification is enhanced through the development of personal identification. According to the Erikson's developmental model, during adolescence, adolescents develop a "sense of self and personal identity" (Rosenthal, Gurney and Moore, 1981; Jones et al., 2014). They begin as adolescents and continue into adulthood outlining and exploring not only who they are and what they identify with, but how they will stay true to themselves (Jones et al., 2014). Female adolescents were chosen as the focus of this study because it has been proven that boys are more physically active than girls (CDC, 2014). Research by Boone and Gordon-Larsen in 2007 also

found that decreased screen time was associated with lower prevalence of obesity in girls. This study sought to study female adolescent physical activity levels. This study includes maternal respondents as a reflection of the National Survey of Children's Health 2011-2012 in which over 50% of parental respondents were mothers. It was hypothesized that the neighborhood characteristics that would most influence physical activity would be neighborhood safety and social capital. Built environment was not hypothesized to be a significant characteristic in influencing physical activity and obesity status in adolescents. Physical activity was also hypothesized to be a predicting factor of obesity status. The research framework is outlined in Figure 1.

Figure 1: Conceptual Model



METHODS

Study Data

Data were gathered for this study using the 2011-2012 National Survey of Children's Health (Appendix1). This survey was conducted by the Center for Disease Control's National Center for Health Statistics, State and Local Area Integrated Telephone Survey program. This survey serves to "assess the physical and emotional health of children aged 0 to 17 years, as well as factors that relate to child well-being, including medical homes, family interactions, parental health, school and after-school experiences, and neighborhood characteristics (Data Resource Center, 2014)" Data were collected from February 2011 until June 2012. The languages included in this survey were English, Spanish, Mandarin, Cantonese, Vietnamese and Korean.

Participants

Participant eligibility for the 2011-2012 survey given by the National Survey of Children's Health was determined through a screening for residential status with household children aged 0 to 17 years of age in the United States and the United States Virgin Islands. Participants were then interviewed and surveyed by landline and cellular phones. Specifically, households that provided cellular phone information for this study were only considered eligible if they did not own a landline telephone or were unlikely to be reached until April 2011 when cases were no longer screened for cell-only/mostly status. A household adult was considered to be a respondent for this survey if they were "a parent or guardian with the knowledge of health and health care of the sampled child in the household (Data Resource Center, 2014)." 68.6% of the respondents were mothers (biological, step, foster, or adoptive), 24.2% were fathers (biological, step, foster, or adoptive) and 7.2% were other relatives and guardians. In the present study, the full NSCH sample (n= 95,667) was limited to female adolescents aged 12-17 (n= 10,881). The mother of each female adolescent included in this study responded to questions about the characteristics of the neighborhood where their daughters lived and their daughter's activity patterns .The mothers of the daughters were the only respondents.

Procedure

This survey is a cross-sectional telephone survey of US households with at least one child aged 0 to17 when the interview was conducted. Households were chosen as a result of "list-assisted random–digit dial sample of landline telephone numbers and was supplemented with cellular phone numbers with stratification taking place by state." There were 95,667 interviews completed for the landline phone sample in the United States including the District of Columbia. On average, landline phone interviews in this sample took 33 minutes to complete. There were 51,972 cellular phone interviews completed in this sample for the same geographic location. The average length of the interview for the cellular phone sample was 34 minutes. There were also 2,342 interviews completed in the United States Virgin Islands that were not included in this data set.The comprehensive response rate (includes finishing the end of the survey – section 6 for children less than 6 years of age and section 7 for children 6 to 17 years of age) was 54.1% for the landline sample and 41.2% for the cellular phone sample.

Measures

Weight Status. In order to assess the relationship between neighborhood characteristics and its association to female adolescent activity, which overall influences weight status, variables were assigned based upon the data available in the National Survey of Children's Health. Obese status was assigned based on the participant's Body Mass Index. Participants that had a body mass index in the 85th – 95th percentile and higher were labeled as overweight, and participants considered obese had a body mass index in the 95th percentile or higher. In the National Survey of Children's Health, body mass index was used.

Neighborhood Characteristics. The construct of neighborhood characteristics (NC) was characterized by variables in the data set that were categorized as measures of built environment, social capital and neighborhood safety. These variables express the dominant qualities that have an impact on outdoor physical activity that should take place in neighborhoods and communities.

Built Environment. There were two questions mothers answered with yes or no pertaining to built environment. The first question was "does a library or bookmobile exist in your community?" The second was "does a recreation center, community center or boys' or girls' club exist in your neighborhood?"

Neighborhood Safety. Neighborhood safety was assessed by a question that asked about how safe the child felt in their community or neighborhood. For this question the mother responded on a scale of 1 (never) to 4 (always).

Social Capital. The last subdomain under the construct of neighborhood characteristics was social capital, specifically measured by four questions. The first question asked mothers whether people in their neighborhood help each other out. The second question asked whether adults watch out for each other's children. For the third question, mothers responded to whether or not there were people in the neighborhood that they could count on. Lastly, mothers responded to the question that asked "if my child were outside playing and got hurt or scared, there are adults nearby who I can trust to help my child." Mothers responded from 1 (definitely agree) to 4 (definitely disagree).

Activity Patterns. The construct of physical activity (PA) is characterized by variables in the data set that were collected as measures of sedentary activity and weekly physical activity. These variables express two dominant forms of physical activity (CDC, 2014).

Sedentary Activity. Mothers reported the average amount of time that their child spends watching TV programs, videos, or playing video games on an average weekday in hours or minutes. A code was given if a television was not present in the household and if the child spent no time in front of the television.

Weekly Physical Activity. Mothers answered a question about the amount of time during the past week (number of days) that their child exercised, played a sport, or participated in physical activity for 20 minutes or more that made him or her sweat or breathe hard (basketball, walking, active dance, etc.). Mothers gave a specific number of days as a response.

Statistical Analyses

All data analyses were conducted using Statistical Analysis Software (SAS) version 9.2. Associations between neighborhood characteristics (neighborhood amenities, built environment, social capital and neighborhood safety) and activity patterns (sedentary and weekly physical activity) were examined using linear regression. Cronbach's alpha was used to examine scale reliability for the social capital scale. Logistic regression was used to measure the degree to which the aforementioned variables predict adolescents' odds of obesity. Correlations and p-values ($p \leq .05$) were examined to understand relations among predictor variables. The data were also restricted to female adolescents and mothers. There were no stipulations set for geographic location, therefore, all female participants within the ages of 12-17 were included in the analysis. Socioeconomic status was included in this study based on mother's highest level of completed education and the poverty level of the household as established by the United States Department of Health and Human Services.

RESULTS

Sample characteristics. The sample descriptions by demographics and child health are presented in Table 2. Over 50% of the sample identified as non-Hispanic, White (57%) with the remaining sample identifying as Hispanic (20%) and Black (15%) and other (8%). Nearly 12% of families experienced household financial hardship; 66% of the female adolescents had mothers with more than a high school education. Approximately 12% of the sample came from single, female-headed households. The overall proportions of obese and overweight children were 33% and 12%, respectively.

Table 2: Sample Characteristics (n=10,881)

DEMOGRAPHICS	**SAMPLE FREQUENCY**
Non-Hispanic, White	57%
Hispanic	20%
Non-Hispanic, Black	15%
<HS Education (Mothers)	12%
>HS Education (Mothers)	66%
Single, female-headed household	27%
Household Financial Hardship	12%
CHILD HEALTH	
Overweight (BMI $\geq$ 85th percentile)	33%
Obese (BMI $\geq$ 95th percentile)	12%

Associations between female adolescent activity pattern frequency and neighborhood characteristics. Female adolescent activity patterns are presented in Table 3. Mothers reported that their daughters had a mean of [3.76 (.05)] days of frequency in physical activity per week. For sedentary activity, mothers reported that their daughters spent an average of [109.71 (2.24)] minutes watching TV and DVDs or playing videogames out of 180 minutes (3 hours) each day of the week. Neighborhood characteristics showed that there was a mean of [3.38 (.01)] for social capital and [3.36 (.01)] for neighborhood safety. These results show that there was a large proportion of mothers in the sample that reported high levels of neighborhood social capital and neighborhood safety in their neighborhood communities and environments. Built environment was not significant in this study as it was not significantly related to adolescent activity patterns and obesity.

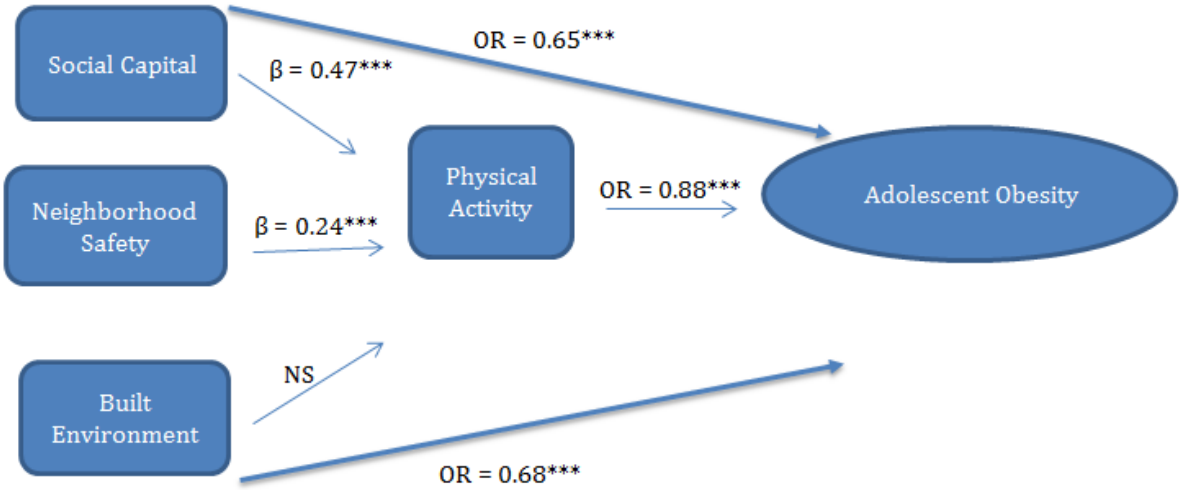
Table 3: Descriptive Information (n=10,881)		
	Mean (SE)	**Range**
CHILD PHYSICAL AND SEDENTARY ACTIVITY		
Physical Activity Frequency (days/week)	3.76 (.05)	0-7
TV/DVD/Video Game Time (min/week)	109.71 (2.24)	0-480
NEIGHBORHOOD CHARACTERISTICS		
Social Capital	3.38 (.01)	1-4
Neighborhood Safety	3.36 (.01)	1-4

Associations between female adolescent activity pattern frequency and neighborhood characteristics by obesity status. Physical and sedentary activity patterns by adolescent obesity status are presented in Table 4. Mothers reported physical activity per week for their daughters that were obese as having a frequency of [3.20 (.16)] days, and mothers of non-obese female adolescents reported a physical activity frequency of 3.83 (.05) days. Mothers of female adolescents that were obese reported that their daughters spent [101.82 (2.13)] minutes watching TV and playing videogames while mothers of non-obese female adolescents reported that their daughters spent [128.66 (6.45)] minutes watching TV and playing videogames per day. Social capital was higher in environments of non-obese female adolescents [3.41 (.02)] than for obese female adolescents [3.17 (.05)]. Neighborhood safety was also higher in neighborhoods of non-obese female adolescents [3.39 (.02)] than for obese female adolescents [3.15 (.07)].

Table 4: Means (SE) by Childhood Obesity Status (n=10,881)		
	Obese	**Non-Obese**
CHILD PHYSICAL AND SEDENTARY ACTIVITY		
Physical Activity Frequency (days/week)	3.20 (.16)	3.83 (.05)
TV/DVD/Video Game Time (min/week)	101.82 (2.13)	128.66 (6.45)
NEIGHBORHOOD CHARACTERISTICS		
Social Capital	3.17 (.05)	3.41 (.02)
Neighborhood Safety	3.15 (.07)	3.39 (.02)

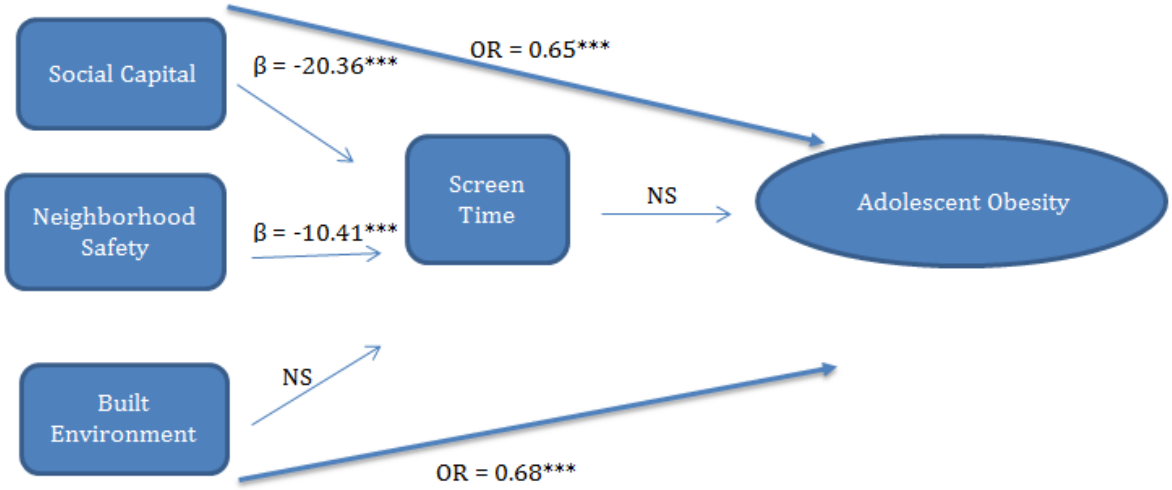
Regression associations between female adolescent physical activity and neighborhood characteristics. The association between physical activity in female adolescents and neighborhood characteristics is presented in Figure 5. These findings suggest that higher levels of social capital ($\beta = 0.47$) were related to higher levels of female adolescent physical activity. Higher levels of neighborhood safety ($\beta = 0.24$) were also related to higher levels of female adolescent physical activity. Built environment was not related to physical activity. Greater female physical activity was associated with reduced odds of having an obese status for female adolescents. Greater social capital was associated with a reduced odds of being obese as a female adolescent (OR=0.65). Greater neighborhood safety was associated with a reduced odds of being obese as a female adolescent as well (OR= 0.88). Built environment was also associated with a reduced odds of being obese as a female adolescent (OR= 0.68). Compared to adolescents with lower physical activity, adolescents with higher physical activity were less likely to be obese.

Figure 5



Regression associations between female adolescent sedentary activity and neighborhood characteristics. The association between female adolescent sedentary activity and neighborhood characteristics is presented in Figure 6. These findings suggest that higher levels of neighborhood social capital (β = -20.36) were related to lower levels of sedentary activity in the form of screen time. Higher neighborhood safety (β = -10.41) was also related to lower levels of screen time. Built environment was not related to screen time. Screen time was not significantly associated with adolescent obesity. Greater social capital was associated with a reduced odds of being obese as a female adolescent (OR=0.65). Built environment was also associated with a reduced odds of obesity in female adolescents (OR = 0.68). Neighborhood safety, conversely, was not significantly associated with adolescent obesity.

Figure 6



DISCUSSION

Female adolescents 12-17 years were more physically active in neighborhoods that had higher levels of neighborhood safety and social capital. Greater levels of physical activity were associated with reduced odds of being obese. There were also lower levels of screen time for female adolescents in neighborhoods that had higher levels of social capital and neighborhood safety. Screen time, however, was not significantly associated with obesity. The previously stated lack in association between screen time and obesity for adolescent females does not support the research findings on screen time found by Boone and Gordon-Larsen in their study "Screen time and physical activity during adolescence: longitudinal effects on obesity in young adulthood." The findings from Boone and Gordon-Larsen suggested that less screen time was associated with a lower prevalence of obesity in females. This study, however, does suggest that neighborhood safety and social capital were predictors of physical activity and were associated with reduced odds in obesity status in female adolescents. The findings of this study are congruent with findings found by Kimm 2008 that studied the decline in physical activity in black girls and white girls. Both studies suggest that lower levels of social capital will lead to reduced levels of physical activity and will increase the likelihood of obesity.

The results of this study suggest that built environment is not significantly related in determining the activity patterns of female adolescents with both physical activity and screen time. However, built environment was associated with reduced odds of obesity in female adolescents. Many studies have sought to explore the role of built environments and physical activity such as the study done by Sallis in 2006. This study concluded that there was an association between built environment and physical activity. Conversely, other studies such as one exploring influence of social and physical environments by Franzini in 2009 have negated the association between built environment and physical activity. The influence of built environment on physical activity has been inconsistent as research has provided conclusions supporting and negating how built environment and physical activity are related. Consequently, further research will be needed in order to state a definitive conclusion (Ding, 2011; Sallis et al., 2006; Gordon-Larsen and Nelson, 2006). When focusing on the factors of built environment, which included the presence of amenities (i.e. recreation center, community center, or boys' or girls' club, libraries and book mobile), there was no association between the female adolescent activity patterns of physical activity and screen time. Built environment also was not significantly associated with obesity as well, confirming the findings of Franzini et al. from 2009.

Findings on neighborhood safety are also analogous with previous research that stated an association between higher levels neighborhood safety and higher levels of physical activity. The results of this study did not support the lack in association found between neighborhood safety and physical activity in the review of literature conducted by Davison in 2006. Research findings of neighborhood safety support lower levels of neighborhood safety in areas of lower socioeconomic status as concluded by Ding in 2011. Despite inconsistencies found in research, findings from this research study support the conclusion that higher levels of perceived neighborhood safety are related to higher levels of physical activity. It also supports the findings of research done by Franzini (2009) and Singh (2010) that concluded that higher levels of neighborhood safety were associated with a reduced risk of obesity. While this study cannot

confirm the odds of youth being obese or overweight to an exact percentage as done in by Singh in 2010 (it was stated the odds of being obese or overweight were 20-60% higher among children in neighborhoods with unsafe surroundings), results of this study do support a correlation between neighborhood safety and physical activity.

The strengths of this study include using a nationally representative data set, thus, the findings can be generalized to all females ages 12-17 years living in the United States. There were also separate constructs to outline adolescent activity patterns which included physical activity and sedentary activity. This allowed a wide spectrum of activity patterns to be accounted for. However, there were limitations to this study, which include using parental respondents of adolescents in the data set. Some results of the study could have been biased because there is no way to ensure that the information provided on the youth included in the data set is accurate. There were also limited data for the variables that were included in this study. For measures of neighborhood safety, screen time and weekly physical activity, only one item in the data set applied and could be used. It would have been more resourceful to have a wider range of questions in the data set about each of the measures listed. This would be useful in controlling the data and exercising more discretion on the part of the researchers thus allowing for more selectivity in choosing questions to best represent the measures.

For future research it would be interesting to examine the same question using males, specifically fathers and sons. Although the National Survey of Children's Healthy 2011-2012 data set is comprised of mostly maternal respondents for youth included in the study, it would be interesting to see how the results differ and what commonalities are shared. Further research could also include testing the same research question in different countries with different levels of industrialization using similar data sets to the National Survey of Children's Health for those countries to compare data to that of the United States. As a continuation of this research study, researchers would use another data set such as the National Health and Nutrition Examination Survey with the same stipulations used in this research study in order to gain access to more questions that would describe the measures of the study. In addition, controlling for socioeconomic status would lead to a better understanding of how the variables are correlated with each other. This research question could also be explored only using built environment as a predictor of female adolescent activity patterns to establish a definitive conclusion.

CONCLUSION

Results of this study suggest that female adolescents were more physically active in neighborhoods that had higher levels of neighborhood safety and social capital. Greater levels of physical activity were also associated with reduced odds of being obese. There were also lower levels of screen time for female adolescents in neighborhoods that had higher levels of social capital and neighborhood safety. Screen time, conversely, was not significantly associated with obesity. The results of this study suggest that built environment is not significantly related in determining the activity patterns of female adolescents with both physical activity and screen time. However, built environment was associated with reduced odds of obesity in female adolescents. The results of this study suggest and confirm the measures of social capital and neighborhood safety relating to physical activity. Neighborhood characteristics are also associated with reducing odds of obesity status.

APPENDICES

Appendix A: National Survey of Children's Health 2011-2012 Data Set Questions

Construct	Variable Name	Label
Built Environment	K10Q13	Does a recreation center, community center, or boys' or girls' club exist in your community?
	K10Q14	Does a library or bookmobile exist in your community?
Social Capital	K10Q30	People in this neighborhood help each other out.
	K10Q31	We watch out for each other's children in this neighborhood.
	K10Q32	There are people I can count on in this neighborhood
	K10Q34	If my child were outside playing and got hurt or scared, there are adults nearby who I trust to help my child.
Neighborhood Safety	K10Q40	How often do you feel [S.C.] is safe in your community or neighborhood?
Weekly Physical Activity	K7Q41	During the past week, on how many days did [S.C.] exercise, play a sport, or participate in physical activity for at least 20 minutes that made [him/her] sweat and breathe hard?
Screen Time	K7Q60	On an average weekday, about how much time does [S.C.] usually spend in front of a TV watching TV programs, videos, DVDs, or playing video games? (Length of time)

REFERENCES

Boone, J. E., Gordon-Larsen, P., Adair, L. S., & Popkin, B. M. (2007). Screen time and physical activity during adolescence: longitudinal effects on obesity in young adulthood. *International Journal of Behavioral Nutrition and Physical Activity*, *4*(1), 26.

Center for Disease Control and Prevention: Division of Nutrition, Physical Activity and Obesity (2014). *How much physical activity do you need?* Retrieved from: http://www.cdc.gov/physicalactivity/index.html

Center for Disease Control and Prevention: Division of Nutrition, Physical Activity and Obesity (2014). *Childhood Overweight and Obesity.* Retrieved from: http://www.cdc.gov/obesity/childhood/index.html

Data Resource Center for Child & Adolescent Health (2014).*The National Survey of Children's Health.* Retrieved from: http://childhealthdata.org/learn/NSCH

Davison, K. K., & Lawson, C. T. (2006). Do attributes in the physical environment influence children's physical activity? A review of the literature. *International Journal of Behavioral Nutrition and Physical Activity*, *3*(1), 19.

Ding, D., Sallis, J. F., Kerr, J., Lee, S., & Rosenberg, D. E. (2011). Neighborhood environment and physical activity among youth: a review. *American journal of Preventive Medicine*, *41*(4), 442-455.

Franzini, L., Elliott, M. N., Cuccaro, P., Schuster, M., Gilliland, M. J., Grunbaum, J. A.,… & Tortolero, S. R. (2009). Influences of physical and social neighborhood environments on children's physical activity and obesity. *American Journal of Public Health*, *99*(2), 271.

Gordon-Larsen, P., Nelson, M. C., Page, P., & Popkin, B. M. (2006). Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics*, *117*(2), 417-424.

Jones, R. M., Vaterlaus, J. M., Jackson, M. A., & Morrill, T. B. (2014). Friendship characteristics, psychosocial development, and adolescent identity formation. *Personal Relationships*, *21*(1), 51-67.

Kimm, S. Y., Glynn, N. W., Kriska, A. M., Barton, B. A., Kronsberg, S. S., Daniels, S. R., ... & Liu, K. (2002). Decline in physical activity in black girls and white girls during adolescence. *New England Journal of Medicine*, *347*(10), 709-715.

McMurray, R. G., Harrell, J. S., Deng, S., Bradley, C. B., Cox, L. M., & Bangdiwala, S. I. (2000). The influence of physical activity, socioeconomic status, and ethnicity on the weight status of adolescents. *Obesity Research*, *8*(2), 130-139.

McNeill, L. H., Kreuter, M. W., & Subramanian, S. V. (2006). Social environment and physical activity: a review of concepts and evidence. *Social Science & Medicine*, *63*(4), 1011-1022.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of Childhood and Adult Obesity in the United States, 2011-2012. *Journal of the American Medical Association, 311(8):*806-814. doi:10.1001/jama.2014.732.

Popkin, B. M., Duffey, K., & Gordon-Larsen, P. (2005). Environmental influences on food choice, physical activity and energy balance. *Physiology & Behavior*, *86*(5), 603-613.

Parsons, T. J., Power, C., Logan, S., & Summerbelt, C. D. (1999). Childhood predictors of adult obesity: a systematic review. *International Journal of Obesity*, *23*.

Rosenthal, D. A., Gurney, R. M., & Moore, S. M. (1981). From trust on intimacy: A new inventory for examining erikson's stages of psychosocial development. *Journal of Youth and Adolescence*, *10*(6), 525-537.

Sallis, J. F., & Glanz, K. (2006). The role of built environments in physical activity, eating, and obesity in childhood. *The Future of Children*, *16*(1), 89-108.

Singh, G. K., Kogan, M. D., Van Dyck, P. C., & Siahpush, M. (2008). Racial/ethnic, socioeconomic, and behavioral determinants of childhood and adolescent obesity in the United States: analyzing independent and joint associations. *Annals of Epidemiology*,*18*(9), 682-695.

Singh, G. K., Siahpush, M., & Kogan, M. D. (2010). Neighborhood socioeconomic conditions, built environments, and childhood obesity. *Health Affairs*, *29*(3), 503-512.

Wareham, N. J., van Sluijs, E. M., & Ekelund, U. (2005). Physical activity and obesity prevention: a review of the current evidence. *Proceedings of the Nutrition Society*, *64*(02), 229-247.

The Politics of Participation: The Association Between School Racial Composition and Civic Engagement Later in Life

Sheryl-Amber B. Edmondson, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisors:
Erica Frankenberg, Ph.D
Assistant Professor of Education
Department of Education Policy Studies
College of Education
The Pennsylvania State University

Suet-ling Pong, Ph.D
Professor of Education, Sociology and Demography
Department of Education Policy Studies
College of Education
The Pennsylvania State University

Abstract

Civic engagement is a primary goal of education, the cornerstone of democracy; therefore inherently linked to diversity. In a nation experiencing multiculturalism and a resurgence of segregation simultaneously one might question how school racial context becomes the means to civic engagement. Researchers debate whether racial composition undermines or facilitates civic engagement, but there is consensus that it affects students' access to civic education resources and sense of community and belonging. Using data from the Educational Longitudinal Study of 2002, this study examines the association between school racial composition and a person's likelihood to engage in civic behavior later in life.

Introduction

School racial segregation continues to impact American democracy; this phenomenon reinforces the importance of research on civic engagement. Recent landmark cases such as *Board of Education v. Dowell, Freeman v. Pitts, and Parents Involved in Community Schools v. Seattle School District No. 1* correlate with a significant increase in resegregated K-12 schools in the United States (Martin, 2004; Thro & Russo, 2009**)**. Contrary to the *Brown v. Board of Education of Topeka* ruling, contemporary Supreme Court decisions refuse to acknowledge the necessity of racial integration in schools and the workplace. These cases not only eliminate federal supervision of the integration efforts of public schools, but also make race-based admissions in primary and secondary schools illegal. As schools become more and more segregated, the role of school segregation on civic engagement remains an urgent concern for sociology researchers.

Dating back to its foundation, public school, or "common school" as it was originally named, was a political institution. George Washington and Thomas Jefferson were both particularly concerned with finding the nations next great political leaders through the schooling process; public schools were charged with educating qualified leadership for a democratic government. Schools, in theory, were to act as miniature societies; places where citizens would learn to obey the law by obeying school rules; to accept a common set of political beliefs; to provide equal opportunity for all students to be elected into office; and to educate students to be involved in community activities (Spring 2012). Now, not only are schools designed to act as miniature societies, but also as a remedy for many societal ills such as poverty, drugs and racial intolerance.

Several of these societal ills have been found to be assuaged by school desegregation. School desegregation has a host of benefits for students including increased academic achievement and aspirations, lower incarceration rates, higher graduation and employment rates, and tolerance and preference for mixed racial environments (Mickelson & Nkomo 2012). Since the ruling of Brown v. Board of Education during May of 1954 it has been a common ideology that the separation of the races has no place in the public domain, particularly in the area of education. It took many years, several policies and countless efforts- some fruitless, some successful- to attempt at desegregating our nation's public schools, because resisting to do so was now inherently unequal and unlawful. Desegregation did not take place immediately, however, it was not until a year later that the Court handed down a plan for how desegregation was to proceed and, for some states, over a decade before they were to lawfully abide by the order (Alexander v. Holmes County Board of Education). However, it was not long before desegregation orders had been federally abandoned as the result of several cases, a few being Board of Education v. Dowell, Freeman v. Pitts. These cases resulted in decisions that stated once a district reaches unitary status- once it has been successful in meeting part of the goals of a desegregation plan- the federal court's business in that portion of the plan is obsolete, in addition to rejecting the use of race in admitting students to public schools. These landmark cases spoke volumes to the peoples of our nation as schools were no longer legally required to desegregate, even if the result could be resegregation.

Over the past few decades there has been a resurgence of segregation in America's public schools. The effects of this segregation interest researchers and educators alike. The increasing diversity in America and the increasing segregation in schools cause many to wonder how students can be trained as future citizens in a world that looks much different than their classrooms. Frankenberg (2013) contended that children who live in racially segregated communities, more often than not, attend racially segregated schools. From the perspective of the perpetuation theory, children who attend racially segregated schools will, by and large, experience racially segregated environments throughout their lives; likewise, those who experience schooling in a racially diverse context are more likely to experience racially diverse settings in the future (Stearns, 2010). As public schools undertake the task of preparing future active citizens, they must keep in mind how diversity and racial homogeneity in schooling contribute to that outcome.

Civic engagement allows citizens the freedom and space with which to exercise rights, such as petitioning, assembling and speaking- while also holding them accountable to take care of the less fortunate and tackle public issues (McBride, Sherraden, & Pritzker, 2006). The purpose of civic engagement is solidarity and social cohesion amongst the citizens of a nation. In a democratic country such as the United States the ways in which and the extent to which people

participate in their communities is of utmost importance. Multicultural nations have a duty to ensure that citizens are well-equipped with the skills and experiences to live, work, and participate in a diverse milieu. Schools have played a major role in preparing students for life as future citizens. Because public schools are often charged with this task, integrated schooling becomes paramount to life in a nation where many cultures and ethnicities coexist. Schools that represent a diverse student body allow for more positive race relations between future voters and participators and are better equipped to prepare children for life in a multicultural society. In recent years there has been an ongoing debate between researchers about whether diversity or racial homogeneity facilitates civic engagement. This study focuses on the aforementioned discord, and more specifically, whether diversity or homogeneity in schooling is associated with civic engagement later in life.

In this paper I will review the various definitions of civic engagement and the implications of such diverse definitions on the outcomes of studies. In addition, I will explore the relevant research on the competing perspectives of how the racial composition of schools and communities is associated with civic engagement. Because I am testing the effect of institutional characteristics on individual outcomes I account for the three individual characteristics that could impact my findings- race, socioeconomic status, and immigrant status. Finally, I will then move forward to an analysis of data from the Educational Longitudinal Study of 2002, a nationally representative sample of 10th graders, to find how school racial composition is associated students' propensity to engage in civic behavior later in life.

Review of the Literature

The literature review below will discuss the various definitions of civic engagement and explores how these definitions influence the way in which it is studied. It will then move forward to explore the literature on the association between civic engagement and racial composition. Because of the lack of extensive literature on civic engagement and racial composition in schools I have included literature on civic engagement and the racial composition of neighborhoods. I also argue that mixed racial composition in schools is associated with one's proclivity towards diverse settings later in life. Finally, I discuss the three moderating variables (race, socioeconomic status, and immigrant status) that may affect the relationship between school racial composition and civic engagement later in life.

Definitions of Civic Engagement

Robert E. Putnam first brought the concept of civic engagement into contemporary scholarly conversation with his books *Bowling Alone: The Collapse and Revival of American Community (2000)* and *Making Democracy Work (1993)*. Putnam was far from providing the conclusive work on civic engagement, but is cited by a preponderance of researchers studying the concept. Putnam asserts that since the post-war era Americans participate much less in the lives of their communities, thus becoming civically disengaged. This lack of civic engagement, he contends, has led to a weakened social capital, social networks necessary for community, collective action, and democratic participation (Boggs 2002). Sociological studies about civic engagement vary widely in the ways in which it is both referred to and discussed. In particular, researchers debate about individual vs. collective action; informal vs. formal activity; and homogenous vs. heterogeneous participation.

First, researchers' definitions of civic engagement differ from study to study because of discord concerning the term's meaning. Some define civic engagement by the behavior of an individual; such as participating in service work. In contrast, various definitions deemphasize individual activity, instead focusing on collective action as the primary tenet of civic engagement; specifically the interfacing of individuals toward a public, community or political end. These definitions of civic engagement describe it as collaborating, solving problems through our political process, and influencing the larger civil society. Other definitions distinguish individual and collective action between 'civic' and 'service'. "Service implies doing for and civic implies doing with. Service is about meeting people's needs. Civic is about deliberations and public work aimed at some public issue or challenge." The lack of a clear-cut definition of civic engagement allows scholars the freedom to define it as they see fit; variance in definitions of civic engagement then leads to variance in findings concerning the term. For instance, Robert E. Putnam, renowned political scientist, discussed social capital as the by-product of civic engagement; therefore, his description of civic engagement largely included social activities such as club meetings, friend visits, card games and the like. How civic engagement is defined is dependent upon the perspectives and interests of the definer; this certainly impacts the ways in which it is researched (Adler & Goggin 2005).

Second, civic activities include a variety of activities existing on a spectrum from informal to formal actions performed by individuals alone or individuals participating in a group. In their work *what do we mean by "civic engagement?"* Adler and Goggin (2005) created a *continuum on civic engagement.* At the far left (informal) end of the spectrum are acts such as "helping a neighbor" and "engaging in political discussion with friends" while on the far right (formal) end of the spectrum is "sustained intensive service" (such as AmeriCorps) and "running for public office." Predictably, informal measures of civic engagement would result in higher frequency of the acts performed, as the more formal activities require time, resources and networks that would not be available to those living within the constrained environment of an impoverished neighborhood. For instance, blacks as well as whites living in concentrated poverty neighborhoods are found to be less likely to vote, discuss national politics, and express an interest in political affairs (McLean et al. 2002). While many researchers are specifically interested in political behavior, neglecting to include other forms of engagement will certainly distort a study's findings.

Civic Engagement and Racial Composition

The last important area of civic engagement that researchers debate is how racial context affects participation in civic activities. This debate will be the focus of my study. Racial context has been found by several researchers to be associated with the likelihood that one will engage themselves civically; the racial composition of one's surroundings has been found to either undermine or facilitate civic engagement (Oliver 2010; Matsubayashi 2010; Rogers & Chong 2005). Racial context influences citizens' sense of community and belonging, therefore, leaving them feeling as if they are a part of the whole or ostracized. For example, whites and minorities feel a greater sense of community in homogenous neighborhoods (Oliver, year).

Most researchers agree that civic involvement in one's community is dependent upon the racial composition of that community. The divergent viewpoints that follow, however, dispute whether diversity or homogeneity is a prerequisite for civic engagement. Several researchers claim that homogeneity prompts civic participation (Matsubayashi 2010; Merry 2012; Oliver 2010). Others, however, hold the contrasting position that diverse surroundings foster various

predictors of civic engagement such as political discussion, tolerance of other racial groups, and greater civic interest (Mickelson & Nkomo 2012; Campbell 2008; Bowman 2011). The ongoing scholarly debate regarding the racial composition under which civic engagement is best fostered make it an interesting topic to investigate.

A study titled *E pluribus unum: Diversity and Community in the 21st Century*, Putnam asserts that diversity poses a threat to social solidarity and social capital, the byproducts of civic engagement, and that there exists a tradeoff between diversity and community. In accordance with this theory of contextual effects, findings from similar studies contend that a person's likelihood to engage in politics depends largely on the racial composition of the community in which he/she lives. Matsubayashi, in his work *Racial Environment and Political Participation*, found that people's decision to vote depends significantly on the relative proportion of in-group and out-group members in their surroundings. Furthermore, his results show that those living in racially homogenous areas with few out-group members pay more attention to politics (Matsubayashi, 2010). Likewise, another study found that collective consciousness, typically in regards to race, influences political behavior (Rogers & Chong 2005).

Supporters of this theory of homogeneity reject integration as a means to promote civic engagement. The paradoxes of racial integration were explored in a book by J. Eric Oliver. He contended that, although integration is the best way to improve race relations in our nation, it is not an "irreducible good" (Oliver 2010). Citizens feel less of a sense of belonging in heterogeneous communities and so participate in those communities in much lower levels than they would if placed in a homogenous community surrounded by citizens of their own racial group. For instance, Blacks express greater feelings of alienation as the percentage of Whites increase in their neighborhoods; moreover, Blacks civic participation is lower in predominantly White neighborhoods (Oliver 2010 & Wu et al. 2011).

The issue with this theory of homogeneity, however, is that it provides a quick fix for a problem that requires a long-term solution. It does not consider the perpetuation theory: those who experience racially integrated schools grow to have a liking for heterogeneous settings and further are inclined to live and work in more diverse communities (Stearns 2010). Several studies claim that not only is civic engagement weakened in racially heterogeneous communities but that it is best fostered under conditions of segregation. (Oliver 2010). If both racial intolerance and civic engagement are facilitated by segregation, then the founding principles of this nation are not only a falsehood, but a farce as well. Is the very heart of democracy best expressed under conditions which ultimately undermine and defy the concept? The homogeneous condition for civic engagement strengthens the idea of segregation and racial intolerance and isolation; therefore, promoting de facto segregation. Of these studies, few have explored alternatives to these theories, simply accepting segregation as a viable solution. If diversity is a hindrance to civic engagement, then the best proposed solution is to unearth the ways in which people actually do come together in diverse settings, such as within schools.

School Diversity and Politics

Promoting civic values and activities while people are still in their youth is crucial. Schools are universal and are a huge socialization institution for children. Schools provide children with a context outside of home; they may, at times, provide the freedom for students to experience diversity. Schools allow children with limited environments to encounter people and opportunities they may not have otherwise. In this paper, I consider another, more ethical, diverse and democratic way of fostering civic engagement- through the heterogeneous racial

composition of schools. The concept of school diversity is consistent with democratic ideals as noted by philosophers Aristotle and John Stuart Mill. Even recently in landmark Supreme Court cases racial diversity has been found to be a compelling state interest upon grounds to integrate (Parents Involved in Community Schools v. Seattle School District No. 1). Although many researchers agree that racial homogeneity bolsters civic engagement in communities, it also perpetuates racial isolation in schooling, therefore, possibly undermining civic engagement for future adults. Adults' likelihood to engage in activities that contribute to social cohesion depend largely on how well prepared they are to work with a diverse group of people, whether or not their racial fears and stereotypes have been challenged, and the quality of their intergroup relations and intercultural understanding (Mickelson & Nkomo 2012).

It is within the context of schools that children and adolescents learn to deliberate and collaborate with others that are like and unlike themselves. Kahne et al. (2013) found that discussion of societal issues prompts increases in behaviors such as voting and volunteering, commitment to civic participation, and interest in politics. However, according to John Stuart Mill's' marketplace of ideas theorem, diversity in thought is essential for deliberation within a democracy (Mickelson & Nkomo 2012). Diversity within social institutions has also been said to be crucial for racial justice within a democracy. As mentioned earlier in this article, segregated schools, particularly schools with high concentrations of minorities, have been found to have injurious effects on the students who attend them; while integrated schools produce more positive outcomes on adults.

Schools can be effective institutions in cultivating democratic ideals within students. According to Mickelson and Nkomo (2012) integrated schooling is positively related to support of democratic values and greater inclination for aspects of civic engagement. A diverse social environment in schooling gives students the skills necessary for positive interaction with other races and ethnicities later in life. For example, childhood and adult cross-racial contact increases the probability that Blacks will have White friends as adults. Students attending diverse schools are also able to better understand the perspectives of others. Integrated schooling produces cross-racial friendships and positive intergroup relations that are key for participation in a multicultural democracy.

Consistent with Mickelson and Nkomo's review, a study done by Bowman (2011) concluded that how adolescents experience diversity foreshadows their commitment to society as adults. He found that interpersonal interactions with racial diversity were effective in promoting civic engagement. What occurs in the classroom can have a significant impact on a student's commitment to civic participation (Kahne & Sporte 2008). Students' experiences with and exposure to diversity allows them the opportunity to better relate with others within the nation. Those who grow up in racially segregated environments and attend racially segregated schools hold prejudices and fears about others that are harmful to a civil society. Non-existent intergroup relationships perpetuate negative stereotypes which prevent people from getting along. Segregation in schools undermines civic engagement for future adults and defies the concept of democracy in a multicultural nation.

Individual Factors

Historically, race has played a huge role in the civic engagement of Americans. Because of the United States' dark history of segregation and exclusion, minority citizens have been compelled to come together to fight existing inequalities. Grassroots civic engagement is the catalyst for much of the change in federal social policies, such as desegregation, miscegenation

laws, and voter ID laws. A study by Sinclair, Walker, and Gillion (2009) cites authors Rosenstone and Hansen (1993) who concluded that Black and White civic participation changes over time. Black civic participation was related to macro level changes in the political sphere such as Jesse Jackson's presidential bid. While Whites were found to engage in political activities such as writing a congressional representative and signing petitions in 1974, by 1994 these differences were cut in half. By 1994, of the 12 survey items measuring civic engagement, differences only existed in signing petitions, writing letters to representatives, and attending public meetings on local or school affairs. The authors predicted that over time, Blacks' civic engagement would be equivalent to Whites'.

Income level, like race, plays a role in how and whether one engages him/herself civically in the community. Those who have higher income and higher levels of education are more likely to engage themselves in civic activities such as volunteering and group membership. A qualitative study done by McBride et al. (2006) examined the civic engagement of low-income families as well as barriers to civic engagement that these families may face. They contended that, although civic engagement is positively associated with socioeconomic status, this does not mean that low-socioeconomic families do not orient themselves to civic behavior in other ways that are not commonly measured. Over one-third of respondents indicated some involvement with a church, and about 26% discussed community involvement which included providing for the elderly, raising money for a charity, and spending time working with social organizations. Other responses included neighboring, involvement in children's activities, and voting. The primary barrier to civic engagement respondents often discussed was scarce free time. Some stated that they had jobs and family demands that prevented them from engaging themselves in the community. Socioeconomic status indeed plays a role in how people participate in their communities, is often due to a lack of resources and multiple responsibilities that keeps people of low socioeconomic status from engaging in their communities as much as high socioeconomic status people.

Immigrants in the United States have a unique experience compared to other racial minority groups in the country because of two significant barriers: language and citizenship status. In this sense, immigrants face a kind of double oppression. Immigrants in the U.S. are only studied specifically when it comes to immigration policy while other aspects of their incorporation into American life are ignored. The recent mobilization of Latin American immigrants has sparked an interest in civic engagement as it relates to immigrants in the country. Latin Americans, in some cases, are supported by local organizations, churches etc. to facilitate their incorporation into society. However, as previously contended in this paper, context matters. (Donnelly & Selee, 2010).

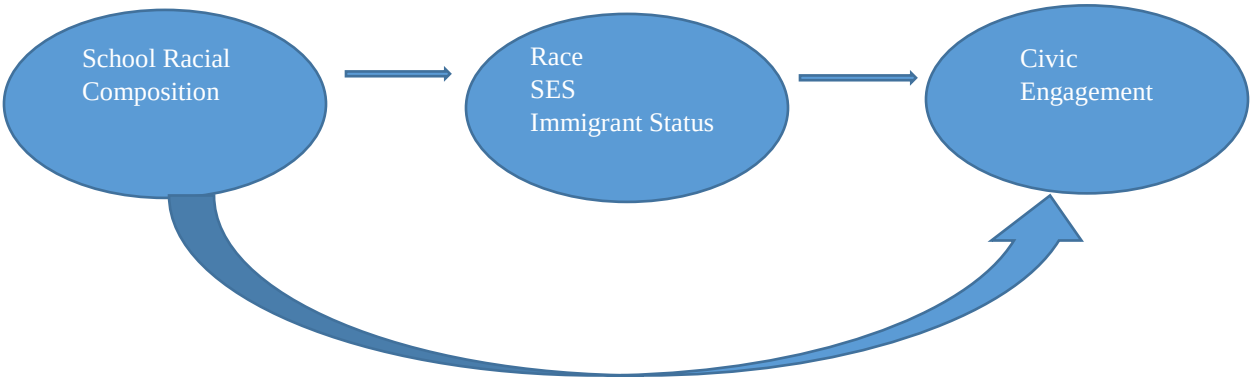
Methodology

The Survey

The Education Longitudinal Study of 2002 (ELS 2002) is a nationally representative sample of 10th graders. ELS 2002 was administered to 750 schools and over 150,000 students during the spring term of the year. Students were initially surveyed in 2002 and completed a series of follow-up surveys afterwards until 2012. Surveys were also administered to parents, administrators, and Math and English teachers during the base year. ELS 2002 also includes student assessments in Math and English as well as high school transcripts.

The Study was created to serve the development and evaluation of education policies at various levels of policy-making. I chose this survey to complete my research because it helps me to understand the impact of various institutional and personal background features on student outcomes later in life. The strengths of using this survey include the following: its wide range of measures to analyze, its longitudinal feature, and its nationally representative feature. Many researchers studying civic engagement choose to use a specific school district or area, however, this limits the study's generalizability.

Conceptual Framework



This study relies on the conceptual diagram above that indicates the predicted relationship between the variables utilized. Because I am measuring individual outcomes, I also account for individual differences that might impact the results of this study, such as socioeconomic status, race/ethnicity, and immigrant status. I predict that school racial composition will have a direct effect on civic engagement later in life, but also that this relationship may be strengthened or weakened depending upon race, socioeconomic status, and immigrant status.

Research Questions

1. Is the racial composition of the school associated with a person's likelihood to engage in civic behavior later in life?
2. Is this association moderated by race/ethnicity?
3. Is this association moderated by SES?
4. Is this association moderated by immigrant status?

Hypotheses

H_1: There will be a negative association between school racial composition and civic engagement later in life

H_2: Blacks and Whites will have higher voting rates than Hispanics; there will be no differences for volunteering

H_3: Students with high socioeconomic status backgrounds will have higher rates of civic engagement in both voting and volunteering

H_4: Being an immigrant will weaken one's likelihood to vote and volunteer

Independent Variable

Racial composition of schools was measured using the variable CP03MIN which indicated the percent minority within a school. From this variable I created a dummy variable PERCMIN, which broke down CP03MIN into quartiles of under 25% minorities in school, 25-49% minorities in school, 50-74% minorities in school and 75% or more minorities within the school. Using this variable over the initial, continuous variable was necessary for analyzing the data and creating graphs.

Dependent Variables

The dependent variables for civic engagement were chosen from a list of variables in the third follow-up questionnaire related to civic engagement. Because some scholars separate political and civic involvement, the two variables were chosen so as to each represent one aspect of each. For each of the dependent variables, responses were coded 0 for "no" and 1 for "yes." The variable chosen to identify political involvement was whether or not one voted in the 2008 presidential election. This variable was chosen very purposely, as this was a monumental time in American political history where macro-level changes affected the civic outcomes of individuals, specifically minority and youth voters. During the 2008 presidential election 23 million young voters cast their ballots, over two-thirds (68%) of whom voted in favor of President Barack Obama. This election caused an increase in young voters, Black and Hispanic voters, new voters, and women (CIRCLE Staff, 2008)

The second dependent variable chosen was whether or not one performed unpaid volunteer service in the past two years (F3D40). This variable was chosen because it includes all areas of service including religious and spiritual organizations, youth organizations, education organizations and more. This item in the questionnaire was the precursor to several items that specify what kind of civic involvement the respondents were involved in and so has a high frequency and a diverse body of possible responses.

Moderating Variables

I chose the public-use race/ethnicity composite variable (a variable that combines all races instead of separating them individually) over all other variable measures of race because it made my analysis of race consistent throughout the study. In addition, for the purposes of this study, I created a dummy variable WBHRACE so as to only look at Black/African-American, Hispanic, and White races; all remaining races are coded as "other." All other races are very small in number, such as American Indian/Alaska Native, or not specific enough for the study (e.g., "more than one race").

I chose Generational Status in order to determine whether or not a survey respondent was an immigrant. I then created a dummy variable IMMSTAT where 1 indicates that the survey respondent was born in Puerto Rico or a non-US country, and 0 indicates the survey respondent was a non-immigrant (i.e., born in the United States).

BYSES2QU was chosen to determine the socioeconomic status of the survey respondent at the time the initial questionnaire was administered. Socioeconomic status was determined by combining father's/guardian's education, mother's/guardian's education, family income, father's/guardian's occupation and mother's/guardian's occupation. Moreover, BYSES2QU was chosen over BYSES1QU because it includes more updated measures of occupational prestige

from the 1989 General Social Survey over the 1961 Duncan SEI-version used in the first quartile coding variable for socioeconomic status.

Analysis

For this study I use Statistical Programming for the Social Sciences (SPSS). The analysis was performed using a cross tabulation, which summarizes categorical data into percentages. These percentages indicate the percent of people within each group that answered "yes" and "no" to the questions about voting and volunteering. The chi-square test evaluates the statistical significance of the patterns observed in the cross-tabulation. In other words, if the p-value is less than .05, then the observed differences in the output are likely to occur in the real world; if the p-value is greater than .05, then the patterns observed in the output may be due to sampling error.

Limitations

The limitation of this study is that all answers provided by respondents are self-reported, therefore, a respondent could possibly answer "yes" to whether or not they performed volunteer work or voted. Both questions used in the dependent variables are subject to social desirability bias in which respondents ascribe to themselves characteristics that are socially desirable. Voting and volunteering are indeed socially desirable traits in a democracy, which depends on the participation of its inhabitants. Another limitation of this study is that, because it uses a nation-wide sample, Whites are overrepresented, which could impact my results.

Findings

I begin my analysis by performing a cross-tabulation of persons who voted in the 2008 presidential election by school racial composition as shown in Table 1. The percentage of people responding "yes" when asked whether or not they voted in the 2008 presidential election lessens as the percentage of minorities in the school increases. In other words, attending a high-minority school is associated with a lower likelihood that an individual will vote in the future. Based on the Pearson's chi-squared test all results are statistically significant.

Table 1. Frequencies of Persons Who Voted in the 2008 Election, by School Racial Composition in School

Percent Minority	Yes	N
Under 25% minority	60.3%	3957
25%-49% minority	59.4%	1902
50%-74% minority	56.9%	1171
75% or more minority	55.5%	1559
Total	41.2%	8589

Note: For all (p<.01)
Source: Education Longitudinal Study of 2002, survey question F3D38

Table 2 shows cross-tabulation results of persons who performed unpaid service work during the last two years by school racial composition. Similar to voting, attending a school with 75% or more minorities is associated with a lower likelihood of performing unpaid service work. This

table displays a negative relationship between school racial composition and likelihood of volunteering later in life. All results were statistically significant.

Table 2. Frequencies of Persons Who Performed Unpaid Service Work During the Last 2 Years, by School Racial Composition

Percent Minority	Yes	N
Under 25% minority	40.6%	3968
25%-49% minority	40.2%	1905
50%-74% minority	39.2%	1178
75% or more minority	33.9%	1566
Total	60.9%	8617

Note: For all (p<.01)
Source: Education Longitudinal Study of 2002, survey question F3D40

The subsequent tables reveal a more complex association between school racial composition and civic engagement by dividing the tables up by each individual factor described earlier in the paper. Table 3 shows the cross-tabulation results for persons who voted in the 2008 presidential election by school racial composition and individual race. In contrast to Table 1, the relationship between school racial composition and civic engagement is reversed in a few instances when moderated by individual race. An increase in the amount of minority students in a school, for Blacks and Whites, is associated with a higher likelihood of voting in the 2008 presidential election. Being Black or White, appears to significantly moderate the relationship between school composition and civic engagement. For example, schools with 75% or more minorities were associated with the highest likelihood of voting for both Blacks and Whites, although for Hispanics it was to be the lowest.

For schools with less than 25% minorities, when separated by individual race, two out of three of the racial categories have greater affirmative responses than when no individual factors are accounted for as in Table 1. Schools with 25%-49% minorities tend to hold some of the highest affirmative responses for voting in the 2008 election across all racial categories. Interestingly, schools with 50%-74% minorities see a 5% drop in affirmative responses for two of the three racial categories in comparison to schools with 25%-49% minorities.

In all four categorizations of racial context, Hispanics fair much lower in voting than Blacks and Whites, especially in schools with 75% or more minorities where only 43.7% of respondents attested to voting in the election. Also, interesting to note is that the notion that Whites do not benefit from being in diverse schools is contradicted by the data presented below. Schools with 75% or more minorities are associated with a higher likelihood to vote in the election than schools with less than 25% minorities for Whites. Across all racial compositions Blacks hold the highest affirmative responses for voting. Individual race indeed moderates the association between school racial composition and civic engagement later in life. All differences were shown to be statistically significant across school composition.

Table 3. Frequencies of Persons Who Voted in the 2008 Presidential Election, by School Racial Composition and Individual Race

Percent Minority	Black	Hispanic	White	N
Under 25% minority	66.7%	49.2%	61.8%	3957
25%-49% minority	75.8%	49.6%	62.7%	1902
50%-74% minority	70.9%	50.2%	57.3%	1171
75% or more minority	74.5%	43.7%	23.5%	1559
Total	1076	1208	4556	8589

Note: All other races excluded from table; For all (p<.01)
Source: Education Longitudinal Study of 2002

Table 4 depicts the cross-tabulation results for persons who performed unpaid volunteer work by school composition and individual race. In schools with under 25% minorities Black and White, respondents reported affirmative responses at similar rates with only a .5% difference between them. Respondents from schools with less than 25% minorities and 50%-74% minorities reported similar affirmative responses across the board for all racial categories. Schools with 25%-49% minorities produced the highest percentage of affirmative responses for Blacks and Hispanics. However, none of the above statistics were statistically significant.

Similarly to Table 2, Table 4, overall, depicts a negative relationship between school racial composition and civic engagement later in life. The only differences observed that were statistically significant were within schools with 75% or more minorities. Compared to the average shown in Table 2, Blacks and Whites reported higher affirmative responses for performing unpaid volunteer work. Hispanics, however, report the lowest percentage of affirmative responses. With majority of the racial contexts Hispanics reported almost identical percentages of affirmative responses.

Table 4. Frequencies of Persons Who Performed Unpaid Volunteer Work During the Last 2 Years, by School Racial Composition and Individual Race

Percent Minority	Black	Hispanic	White	N
Under 25% minority	41.5%	34.1%	41.0%	3968
25%-49% minority	46.2%	34.6%	40.3%	1905
50%-74% minority	41.2%	34.1%	39.9%	1178
75% or more minority	37.3%**	26.5%**	34.8%**	1566
Total	1082	1215	4564	8617

*Note: All other races excluded from table; **(p<.01)*
Source: Education Longitudinal Study of 2002

Just as in voting, schools with 75% or more minorities reported a higher number of affirmative responses from Blacks over all other racial categories. According to the data, race tends to moderate the relationship between school composition and civic engagement later in life only in schools with 75% or more minorities.

Table 5 displays the cross-tabulation results of persons who voted in the 2008 election by school racial composition and socioeconomic status. The data from Table 5 shows compelling results. The statistics for voting in the 2008 election are more similar across socioeconomic status than racial contexts and vary greatly by socioeconomic status. Within each racial context the patterns are similar, about 45% of students in the lowest quartile report voting in the 2008 election, about 55% of students in the second quartile report affirmative responses, about 56% of students in the third quartile, and around 67% of students in the highest quartile. The percentage of affirmative responses for voting deviates greatly from the averages shown in Table 1. There tends to be a negative relationship between school racial context and civic engagement later in life for those within the lowest and second quartiles while a positive relationship is shown for those in the third and highest quartiles. The statistics in the second quartile are the only percentages that come close to those depicted in Table 1.

In schools with 75% or more minorities, those in the third and highest quartiles have an identical likelihood of voting in the 2008 election. Socioeconomic status appears to moderate the relationship between school racial composition and civic engagement significantly. There are few similarities across racial composition, for the differences exist mainly across socioeconomic status. Pearson's chi-squared test showed all results were statistically significant.

Table 5. Frequencies of Persons Who Voted in the 2008 presidential Election, by School Racial Composition and Socioeconomic Status

Percent Minority	Lowest Quartile	2nd Quartile	3rd Quartile	Highest Quartile	N
Under 25% minority	45.2%	56.2%	62.2%	73.8%	3836
25%-49% minority	48.7%	57.5%	60.4%	69.5%	1822
50%-74% minority	46.7%	59.6%	61.0%	65.4%	1117
75% or more minority	49.0%	58.3%	60.9%	60.9%	1417
Total	2081	2094	2026	1991	8192

Note: For all (p<.01)
Source: Education Longitudinal Study of 2002

Table 6 displays the cross-tabulation results of persons who performed unpaid service work by school racial composition and socioeconomic status. Like Figure 5, socioeconomic status is positively associated with performing service work regardless of school racial context, for all racial contexts show similar patterns. The differences exist between the quartiles, with there being about a 20% difference in percentage of affirmative responses between the lowest and highest quartiles. Students in schools with 75% or more minorities are at the biggest disadvantage, reporting the lowest percentage of affirmative responses within each quartile. This

category of racial context deviates from the percentages of affirmative responses shown in all other racial context. All results were statistically significant.

Table 6. Frequencies of Persons Who Performed Unpaid Volunteer Work During the Last 2 Years, by School Racial Composition and Socioeconomic Status

Percent Minority	Lowest Quartile	2nd Quartile	3rd Quartile	Highest Quartile	N
Under 25% minority	32.2%	36.4%	40.5%	51.4%	3846
25%-49% minority	33.2%	33.3%	41.0%	51.5%	1825
50%-74% minority	32.7%	36.2%	44.3%	50.0%	1124
75% or more minority	29.3%	35.3%	36.8%	46.4%	1424
Total	2095	2097	2031	1996	8219

Note: For all (p<.01)
Source: Education Longitudinal Study of 2002

Table 7 displays the cross-tabulation results of persons who voted in the 2008 presidential election by school racial composition and immigrant status. Observations of the data show a negative relationship between school racial composition and civic engagement later in life. School racial context tends to make a significant difference in an immigrant's likelihood to vote. Only 31.1% of immigrant students within schools with 75% or more minorities reported voting in the 2008 election while 48.8% of immigrant students in schools with less than 25% minorities reported voting. In contrast, over 60% of non-immigrants attending schools within all racial contexts reported voting. Across each racial context the statistics vary greatly, with some showing 30% differences in voting between immigrants and non-immigrants. However, for non-immigrants.

Table 7. Frequencies of Persons Who Voted in the 2008 Presidential Election, by School Racial Composition and Immigrant Status

Percent Minority	Immigrant	Non-immigrant	N
Under 25% minority	48.8%	61.9%	3463
25%-49% minority	37.2%	64.1%	1633
50%-74% minority	35.8%	62.1%	989
75% or more minority	31.1%	62.7%	1205
Total	821	6469	7290

Note: For all (p<.01)
Source: Education Longitudinal Study of 2002

Non-immigrants in schools with 25%-49% minorities reported the highest percentage of affirmative responses for voting in the 2008 election while immigrants in schools with 75% or more minorities reported the lowest percentage of affirmative responses. Being an immigrant exacerbates the negative relationship between school racial composition and civic engagement later in life. Non-immigrants, however, regardless of school racial context tend to report high percentages of affirmative responses for voting. All results are statistically significant across racial context.

Table 8 shows the cross-tabulation results for persons who performed unpaid volunteer service in the last two years by school racial composition and immigrant status. For immigrants, there was a lot of variation in affirmative responses by school racial composition. About 50% of immigrants in schools with under 25% minorities gave affirmative answers, while about 30% of immigrants in schools with 75% or more minorities gave affirmative. In contrast, this difference was not as big for non-immigrants whose affirmative answers varied only 4 percentage points from under 25% minorities in schools to 75% or more minorities in schools.

Schools with less than 25% minorities showed the highest percentage of affirmative responses for both immigrants and non-immigrants. Surprisingly, about 10% more immigrants reported performing unpaid volunteer service than non-immigrants. Schools with 75% or more minorities show the lowest percentage of affirmative responses. This exemplifies a negative relationship between school racial composition and civic engagement later in life as shown in Table 2. In schools with 50%-74% minorities there was only a .9% difference in affirmative responses between immigrants and non-immigrants, with non-immigrants reporting more.

Immigrants in schools with under 25% minorities are more likely to perform unpaid volunteer work than non-immigrants under the same school racial context. Because of the variation in affirmative responses by school racial context, I can conclude that racial composition matters more for immigrants than non-immigrants in terms of their likelihood to perform volunteer work in the future. Results from the chi-square test show statistical significance only across schools with less than 25% minorities and 75% or greater minorities.

Table 8. Frequencies of Persons Who Performed Unpaid Volunteer Work During the Last 2 Years, by School Racial Composition and Immigrant Status

Percent minority	Immigrant	Non-immigrant	N
Under 25% minority	50.6%*	41.3%*	3471
25%-49% minority	42.2%	40.8%	1635
50%-74% minority	40.0%	40.9%	995
75% or more minority	29.4%*	37.1%*	1211
Total	822	6490	7312

*Note: *(p<.05)*
Source: Education Longitudinal Study of 2002

Discussion

The findings from this study suggest that, as the percentage of minorities in a school increases, an individual's likelihood to engage in civic behavior later in life diminishes. However, this relationship is moderated greatly by individual characteristics such as race, socioeconomic status, and immigrant status. Although there appears to be a negative relationship between school racial composition and civic engagement later in life, in various instances this relationship becomes positive depending on individual characteristics. For instance, Blacks reported more affirmative responses for voting in the 2008 election as the percentage of minorities in their school increased. Hispanics tended to be most impacted by school racial composition because there was greater variance in the percentages of affirmative responses between school racial composition. In addition, Hispanics had a significantly lower likelihood of voting in the 2008 election than Whites and Blacks. Because the three individual factors are not mutually exclusive it could be possible that many of the Hispanic respondents could have been immigrants without voting rights and thus unable to vote.

In fact, when looking at Table 7 which depicts frequencies of persons who voted by school racial composition and immigrant status there are great disparities between the affirmative responses for voting of immigrants and non-immigrants. These differences are exacerbated as the percentage of minorities in the schools increases. In contrast, there were not huge differences in volunteering between immigrants and non-immigrants. Volunteering is an activity that requires no American citizenship but is free and open to all who live in the country. Immigrants in schools with less than 25% minorities reported more affirmative responses for volunteering than non-immigrants. For immigrants especially, school context matters, as there is more variance in affirmative responses for volunteering by school composition. This finding suggests that ability to engage in civic activities should be taken into account when studying the topic.

Socioeconomic status appeared to be a significant moderating factor. The percentage of affirmative responses for voting and volunteering did not vary much by school racial composition but rather by socioeconomic status. Respondents within each quartile were more similar by socioeconomic status than school racial composition. A respondent's socioeconomic status almost defies racial composition making its effects negligible. Higher socioeconomic status is associated with a significant increase in affirmative responses for both voting and volunteering, while the opposite is true for those of low socioeconomic status. Important to note is that many minority students attend minority-segregated schools of low socioeconomic status which places them at the biggest advantage in regards to civic engagement later in life. Students who attended schools with high concentrations of minorities consistently displayed lower levels of civic engagement. For these reasons, integrated schooling, as a means to positive life outcomes, is still vital. The success of American democracy relies tremendously on the civic participation of its citizens. Multiculturalism, therefore, is a fact that must be embraced and encouraged by school administrators in order for a united, active citizenry to exist. Promoting civic engagement amongst our citizens will prove for better race relations, solidarity, and high levels of social capital. The malady of segregation inhibits diversity and so inhibits the civic participation of Americans in the life of their communities. Integrated schooling could very well prepare our youth to be concerned with the welfare of those within their communities and nation by exposure to different races and ethnicities. This, then, will allow them to peacefully live, work and learn collectively. Integration is not simply a question of the welfare of minority students, but a question of the health of our nation.

References

Adler, R. P., & Goggin, J. (2005). What do we mean by "civic engagement?". *Journal of Transformative Education*, *3*(3), 236-253.

Boggs, C. (2002). Social capital as political fantasy. *Social capital: Critical perspectives on community and "Bowling alone*, 183-202.

Bowman, N. A. (2011). Promoting participation in a diverse democracy a meta-analysis of college diversity experiences and civic engagement. *Review of Educational Research*, *81*(1), 29-68.

Campbell, D. E. (2006). Why we vote: How schools and communities shape our civic life. Princeton University Press.

Campbell, D. E. (2008). Voice in the classroom: How an open classroom climate fosters political engagement among adolescents. *Political Behavior*, *30*(4), 437-454.

CIRCLE Staff. (2008). Young voters in the 2008 presidential election. *CIRCLE Fact Sheet.*

Fox, J., Donnelly, R., & Selee, A. (2010). *Context matters: Latino immigrant civic engagement in nine US Cities*. Washington, DC: Woodrow Wilson International Center for Scholars.

Frankenberg, E. (2013). The Role of Residential Segregation in Contemporary School Segregation. *Education and Urban Society*, *45*(5), 548-570.

Jacobsen, R., Frankenberg, E., & Lenhoff, S. W. (2012). Diverse Schools in a Democratic Society New Ways of Understanding How School Demographics Affect Civic and Political Learning. *American Educational Research Journal*, *49*(5), 812-843.

Kahne, J., Crow, D., & Lee, N. J. (2013). Different pedagogy, different politics: High school learning opportunities and youth political engagement. *Political Psychology*, *34*(3), 419-441.

Martin Jr, B. F. (2004). Fifty years later, it's time to mend brown's broken promise. *U. Ill. L. Rev.*, 1203.

Matsubayashi, T. (2010). Racial environment and political participation. *American Politics Research*, *38*(3), 471-501.

McBride, A. M., Sherraden, M. S., & Pritzker, S. (2006). Civic Engagement Among Low-Income and Low-Wealth Families: In Their Words. *Family relations*,*55*(2), 152-162.

McLean, S. L., Schultz, D. A., & Steger, M. B. (2002). Social capital: Critical perspectives on community and" Bowling alone". NYU Press.

Merry, M. S. (2012). Segregation and civic virtue. Educational Theory, 62(4), 465-486.

Mickelson, R. A., Nkomo, M. (2012), Integrated schooling, life course outcomes, and social cohesion in multiethnic democratic societies. *Review of Research in Education*, *36*(1), 197-238.

Oliver, E. J. (1999). The effects of Metropolitan economic segregation on local civic participation. *American Journal of Political Science*, *43(*1), 186-212.

Oliver, E. J. (2010). The paradoxes of racial integration. Chicago and London: The University of Chicago Press. 133-136.

Putnam, R. D. (2007). E pluribus unum: Diversity and community in the twenty-first century the 2006 Johan Skytte Prize Lecture. *Scandinavian political studies, 30*(2), 137-174.

Rogers, R., & Chong, D. 2005. Racial solidarity and political participation. *Political Behavior, 27*(4), 347-374.

Sinclair-Chapman, V., Walker, R. W., & Gillion, D. Q. (2009). Unpacking civic participation: Analyzing trends in black [and white] participation over time. *Electoral Studies, 28*(4), 550-561.

Spring, J. (1991). *American education. An introduction to social and political aspects*. Addison-Wesley.

Stearns, E. (2010). Long-term correlates of high school racial composition: Perpetuation theory reexamined. *The Teachers College Record, 112*(6), 5-6.

Thro, W. E., & Russo, C. J. (2009). Parents involved in community schools v. seattle school district no. 1: An overview with reflections for urban schools. *Education and Urban Society, 41*(5), 529-543.

Woyshner, C. The National PTA, Race, and Civic Engagement.

A Critical Examination of Diversity in Caregiving: Care Provision for African Americans with Dementia

Jazmine Gordon, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Sinfree Makoni, Ph.D.
Associate Professor of Applied Linguistics and African Studies
Department of Applied Linguistics
College of Liberal Arts
The Pennsylvania State University

Abstract

Many African-Americans affected by Alzheimer's disease, a common neurodegenerative form of dementia, lack access to Speech-Language Pathologists despite the higher incidence of 14% to nearly 100% in this underserved population (Alzheimer's Association, 2003). The aforementioned issue is reflective in Communication Disorders literature about caregiving for dementia patients because the research tends to focus exclusively on Caucasian Americans. To investigate how African-Americans receive care for Alzheimer's disease, this study considers four major factors: sociocultural demographics of these patients, socioeconomic and cultural background of caregivers, contexts and methods of caregiving, as well as medical knowledge about the nature of dementia and effective caregiving approaches. This article suggests that through the work of Speech-Language Pathologists and other health practitioners, careful clinical considerations of cultural differences and further research focusing solely on African-Americans, can combat the differential access to services and treatment.

Introduction

Alzheimer's disease is the most common form of dementia and is expected to dramatically increase over the next half century (Alzheimer's Association, 2003; Cloutterbuck & Mahoney, 2003; Waites, 2009; Gaskin et. al, 2013). Although Speech-Language Pathologists play a major role in rehabilitating these patients, many populations lack access to these caregivers. Consequently, few studies about underserved populations affected by Alzheimer's disease exist in the field of Communication Disorders. In particular, older African-Americans are on fixed incomes, which creates many barriers to even basic medical care, and especially specialty services such as speech therapy. Given that census projections indicate the aging population of African-Americans approximately quadrupling by 2050, their access to treatment options should be more closely examined by health practitioners. This demographic will be susceptible to developing Alzheimer's due to a number of biological, social, economic, and environmental factors (Dilworth-Anderson et. al, 2002; Rovner et. al, 2012/2013). Therefore, this study will investigate family caregiving practices for African-Americans with Alzheimer's disease, emphasize the social and economic issues in caregiving for African-Americans, and offer suggestions to improve the caregiving services for this underserved population.

Significance of Study

In the US, African Americans are two to three times more likely to develop Alzheimer's disease than those from Non-Hispanic Caucasian backgrounds. As of last year, more than 20% of African-Americans were identified as living with the disorder (Gaskin et. al, 2013), and 13% of the care was being provided in the family home context (apa.org/pi/about/publications/caregivers/faq/statistics.aspx). Clinical Speech-Language Pathologists are vital members in the healthcare team for patients with dementia since their services can include creating interventions and memory tools to retain cognition for a longer period (Sander et. al, 2007), 'communication training' to reduce miscommunication in the caregiving relationship (Mason-Baughman & Lander, 2012; Watson et al., 2013), and rehabilitating feeding and swallowing once these functions are impaired during end-stage of the disease. However, most of Speech-Language Pathologists' care provision will be provided in an institutional setting for older adults. This unknowingly excludes cultural groups, like African-Americans, who are already faced with other social and economic inequalities from receiving appropriate restorative care (Gaskin et. al, 2013).

Few studies examine the caregiving dynamics in the African-American population with Alzheimer's disease, unless it is a comparative study with Caucasian-Americans or other ethnic minority groups (Lawton et. al, 1992) – (e.g., Ripich et. al, 1997; Hinton et. al, 2005; Belle et. al, 2006). This could be solely due to the lack of African-Americans participating in dementia research or an inherent longstanding racial bias in medical care (Ballard et. al, 1993; Weitzman & Levkoff, 2000; Cloutterback & Mahoney, 2003). Of those studies, there had been consideration given to cultural differences and values, but not much afterthought for incorporating this scholarship into the reformation of healthcare with an interdisciplinary framework. Since there are limited studies actually discussing the ethnography in care practices for African-American patients with Alzheimer's, this becomes a call for concern and must be understood with "social, medical, and political" perspectives to better understand the equivocal underpinnings at work (Naue & Kroll, 2008).

Research Questions

The intent of this research article is to provide answers to the following questions: 1) How do African-Americans in urban areas receive care for Alzheimer's disease? 2) What are African American caregiver and care recipients' understanding of dementia? 3) How does power and knowledge influence caregiving practices for African-Americans with Alzheimer's disease? It is hypothesized that first, African-Americans receive inadequate medical services thus making caregiving resources limited; secondly, African-Americans' interpretation of dementia is misinformed due to health illiteracy, lack of proper insurance, and socioeconomic status; and lastly that medical and allied health discourse has the power to determine 'appropriate' care practices.

Theoretical Framework

"*Caregiving is one of the fundamental building stones in our world but it is frequently camouflaged*" says Dr. Arthur Kleinman, a psychiatrist at Harvard University, in an interview discussing his experience as a caregiver for his wife with dementia. Due to the nature of dementia (i.e., memory loss, issues with daily living, cognitive decline) and symptoms of

Alzheimer's disease in particular, individuals with dementia will require assistance from a caregiver. Caregiving, as Kleinman defines more in-depth, is "a foundational component of moral experience… envisioned as an existential quality of what it is to be a human being. We give care as part of the flow of everyday lived values and emotions that make up moral experience" (Kleinman, 2010). He proposes prominent ways to shape the culture of caregiving and views cultural systems as an impact on the treatment of bodies, which thus influence the perceptions of health and wellness and human conceptions of medical normality, in both the practitioner and the patient (Kleinman, 1976; Kleinman & van der Geest, 2009; Kleinman, 2010). Kleinman draws upon social logician Michael Foucault's conception of biopower, the interaction of knowledge and power, to keep the systematic nature of society in place through discourse. Foucault argues that, in this society, life has two aspects, population regulation and disciplining individuals (White, 2009). Essentially, individual bodies need to be controlled on the inside and outwardly characterized, which requires the social inaction of "disease" categories (White, 2009). Therefore, the staple of medical discourse and understanding regarding caregiving will mirror the fundamental conventions of the society that yields it (White, 2009). Kleinman has contributed ample medical anthropological literature drawing from these concepts to provide a new outlook and thought process for medical professionals. Overall, his views on caregiving are much more humanistic in nature and less discriminatory than the current U.S. medicalization of caregiving (Kleinman, 1976), and could be a great resource for the African-American culture given their often strong ties to religion, limited health care access, and resistance to specialized medical services.

Literature Review

Barriers to Dementia Research for African-Americans

Recruitment efforts for African-Americans with Alzheimer's disease to join research studies have been extremely difficult over the years (Ballard et. al, 1993; Weitzman & Levkoff, 2000). There is a lack of adequate research on how dementia and Alzheimer's disease impacts African-American patients singularly, despite the fact that this disease is much more prevalent in African-Americans than it is in Caucasian-Americans (Rovner et. al, 2013). The 1993 CERAD study utilized different efforts, such as simple educational brochures and posing a call for more minority caregivers in medical facilities, to help combat the main barriers that often leave African-Americans without proper treatment of the disorder. These main barriers included difficulties with transportation, educational level, economic / financial constraints, perception of inaccessibility, and lack of rapport or cultural ties to the clinical staff. Also, physician referral was a big determinant in African-American patients actually receiving specialized care for dementia (Ballard et. al, 1993). Over twenty years later, and these same issues face the African-American community of dementia patients today (Ballard et. al, 1993).

Socio-Anthropological Views on Dementia

When an individual is diagnosed with dementia, it naturally changes that person's character, not only in their self-image, but also in the eyes of others. The identity change that occurs once diagnosed is permanent, and is frankly incomparable to the expected changes of identity over the lifespan (Naue & Kroll, 2008). So, family caregivers will begin using a medicalized outlook to scrutinize the person with dementia. In turn, this impacts the relationship between the individual deemed as 'demented' and the able-bodied because the caregiver will

better conceptualize the ups and downs that ensues as the disease progresses, but as a tradeoff, aid in the loss of the functional thought and independence of the individual (Naue & Kroll, 2008). Therefore, the medicalization and notion of disease have a strong influence on 'demented' individuals since it governs "interventions for and communication with demented persons" (Naue & Kroll, 2008).

African-Americans live in the culture of 'commonsense' as explanations for illness and disease, as do many other Americans (White, 2009). In short, these are socially constructed ideas, or ideologies, that disguise its true objective to marginalize groups in the 'minority' role (Naue & Kroll, 2008). This structural inequality continues to keep the aging bodied African-Americans in a position that they have been kept in for most of their life. Medical knowledge and practices are social endeavors, the result of conflicting groups defining the environment and its contents, and not the expected product of science or natural surroundings (White, 2009). Other social factors that shape medical practice are the actual doctor-patient relationship. White explains that doctors treat patients in ways that reflect the social standing of the patients. Therefore those of a lower class or status are seen for much shorter periods of time, than those of high social status. The social status of some older African-Americans inherently falls into these categories, their elder and minority statuses, in addition to a 'demented' status (Naue & Kroll, 2008). A sociological perspective is that prevailing social conditions have to be in place before one's ailment transforms into a serious disease; consequently, good social environments would harvest populations that are in good health, much further than medicalization of care would (White, 2009, p.39).

Power Relations in Caregiving for Dementia

Acknowledging the individual with dementia's decline in competence can be an extremely difficult task for the family caregiver, but it is one that is best supplemented with intervention (Dunham & Cannon, 2008; Watson et al., 2013). For example, burdens in the relationship can stem from problematic or resistant behavior to instructions on behalf of the care recipient (Watson et al., 2013). Proper medical knowledge about competence versus incompetence in dementia can provide family caregivers with a boost of confidence in taking overall control and making care decisions (Dunham & Cannon, 2008). Dunham and Cannon (2008) found that the caregiver's idea of power and control proceeded as the disease did. Thus it would be a struggle to capture a balance between control and preserving dignity of the patient (Dunham & Cannon, 2008).

Personhood and citizenship are two social lenses that consider humans in similar ways. When applied to dementia research, these lenses either examine dementia at an individual level (micro) or at a broader level (macro), but not specifically how the individual cases influence dementia in society (Bartlett & O'Connor, 2006). The application of personhood and citizenship in caregiving practices has the potential to increase the dementia patient's agency in socially constructed structures (Bartlett & O'Connor, 2006). The examination of these critical lenses together would expand dementia practice and research, as well as challenge healthcare professionals to reevaluate current practices, adopt innovative methods for better care services for the patients, and offer comfort for family caregivers (Bartlett & O'Connor, 2006; Chenoweth & Spencer, 1986).

Ethnic Minorities and Family Caregiving

A small number of research studies have reported that African-Americans and other minorities tend to standardize serious illnesses, like dementia, instead of acknowledging its severity (Hinton et. al, 2005). According to Hinton et. al (2005) expert clinical care acknowledges a patient and their family's understanding of a medical illness, including its source and nature (Kleinman, 1976; Hinton et. al, 2005). Hinton (2005) examined three different typologies (or explanatory models) used by family caregivers of ethnic minority origins to explain dementia, which are folk, biomedical, or mixed model. In brief, a folk model uses language to explain sickness through largely cultural and traditional experiences, whereas a biomedical model uses language to explain biological behaviors and functions as a disease (Kleinman, 1976; Hinton et. al, 2005). The latter is commonly used by medical professionals (Kleinman, 1976; Hinton et. al, 2005). The sample in Hinton's study revealed that 54% of caregivers believe that dementia [and particularly Alzheimer's disease] is the result of psychosocial stress or natural maturation processes (Hinton et. al, 2005). This belief exemplifies a mixed explanatory model, consisting of biomedical and folk components, despite the fact that older minority adults are not as accustomed to the biomedical model (Hinton et. al, 2005). Even further, these researchers found that minority caregivers and those with lower education held such mixed models of dementia more likely than Anglo-European Americans. These models strongly influence the type of care that the individual with dementia receives, since the family caregiver becomes the sole proprietor in this relationship.

The relationship between family caregiver and care recipient is usually one of significance, since family caregivers across all ethnicities tend to be female family members living with the ill (Lawton et. al, 1992; Hinton et. al, 2005; Dunham & Cannon, 2008; Bookman and Kimbrel, 2011). Dilworth-Anderson et. al (2002) found in their narrative of 59 peer-reviewed articles issued during 1980-2000, that African-American family caregivers conveyed stronger values of familial obligation when compared to Caucasian American family caregivers (Cloutterback & Mahoney, 2003). This fact attributes to why institutional placements and formal assistive care for minority adults occur at lesser rates than Caucasian Americans (Dilworth-Anderson et. al, 2002). In some cases, compliance with formal practices of medical care is viewed as a form of dehumanization of the care recipient (Dunham & Cannon, 2008).

Methods

To investigate the caregiving practices for African-Americans with Alzheimer's disease, this critical examination analyzed more than 20 articles and sources across various disciplines, which included gerontology, medical anthropology, nursing, communication disorders, sociology, and psychiatry. The scholarly search criteria entailed publishing dates that spanned across the last two decades, 1993 – 2013, and the following key terms - African-Americans, African-Americans and Alzheimer's disease, African-American caregivers, caregiving, dementia, dementia caregiving, biopower, biomedicine, explanatory models, and intergenerational relationships. Following the review of literature, reoccurring themes in the discourse regarding caregiving for African-Americans with Alzheimer's disease were considered and included demographics, socioeconomic status, sociocultural values of patients and caregivers, context of caregiving, and medical knowledge. These main considerations aligned with the earlier proposed research questions of this study.

Findings

African-Americans with Dementia:

The Demographic

In the United States, the percentage of African-Americans aged 65 years and older, has increased steadily since 1980 (Waites, 2009). Subsequently, this population is expected to reach 6.9 million by year 2030, and 8.6 million by year 2050 (Alzheimer's Association, 2003; Waites, 2009). When compared to non-Hispanic Whites, the occurrence, rate, and accumulative risk have all been deemed higher in African-American adults (Alzheimer's Association, 2003). For that reason, older African Americans are two to three times more likely to have Alzheimer's disease, with more than 20% of African-Americans currently living with the disorder (Gaskin et. al, 2013). What's more, African-Americans elders are living extensive lifespans, potentially aging across four or more generation of family members (Waites, 2009). African-Americans tend to be diagnosed at a later stage of Alzheimer's disease — limiting the effectiveness of treatments that depend upon early intervention (Alzheimer's Association, 2003).

Socioeconomic Status

Reports from the U.S. Administration on Aging show that African-Americans aged 65 years and older, who served as leaders of their households, held a median income of $35,025 in 2008 (Administration on Aging, 2010). Older African-Americans living on such low and fixed incomes typically have access to governmentally funded services, such as social security (SSI), pensions, and Medicare (Bookman and Kimbrel, 2011). This form of economic support, although beneficial to many lives, faces prominent financial deficits (Bookman and Kimbrel, 2011). For this reason, African-American elders in this demographic are not permitted access to services which allow them to age in their homes comfortably or exclusively in institutional care (Bookman and Kimbrel, 2011).

African-American Caregivers for Dementia:

Who Cares? : Intergenerational Relationships

According to the American Psychological Association (apa.org/pi/about/publications/caregivers/faq/statistics.aspx), 65.7 million people serve as family caregivers. Of that population, 13% are African-American. Family caregivers provide assistance in many phases of dementia care, including emotional support, medication management, as well as aid with activities of daily living, such as toileting, bathing, or eating (Gallagher-Thompson, 2013). In addition, these caregivers are not only providing care for the individual with dementia but they are also balancing care for younger generations, careers, and other personal relationships (Bookman and Kimbrel, 2011). Despite the multitude of responsibilities, African-American caregivers take pride in the opportunity to care for the demented, because caregiving is seen as a "rewarding traditional family value" (Cloutterback & Mahoney, 2003; Gallagher-Thompson, 2013).

Furthermore, the familial responsibility of caring for the ill family member is not only the sole responsibility of the primary caregiver, but a shared duty of "extended" family members and close friends (Dilworth-Anderson et. al, 2002; Cloutterback & Mahoney, 2003; Bookman and Kimbrel, 2011). This reflects the intergenerational social networks of "kinship" formulated

throughout many years, amongst elder African-Americans and their strong ties to blood-relatives and trusted non-members of their family (Waites, 2009).

Contexts of Caregiving:

Urban Areas

Family caregiving in the home context is not limited to African-Americans as a minority group, but it has played a longstanding role in their culture of care (Weitzman & Levkoff, 2000; Rovner et. al, 2013). One African American caregiver in Levkoff's study (1993) remarked "black people don't put their old people in homes" which demonstrates the relationship between culture and home care provision (Weitzman & Levkoff, 2000). One article reports that the delivery of health care for African-Americans is substandard, even after extraneous factors like socioeconomic status and health insurance brand were controlled for (Briggs, 2005).

Sociocultural Values: Religion and Health

Other informal forms of support for family caregiving characterized in the African-American culture are religious prayer and faith in "God's Will", or God's power to determine life's outcomes (Dilworth-Anderson et. al, 2002; Waites, 2009; Rovner et. al, 2013). Rovner et. al (2013) found that African-Americans commonly associate religion and spirituality to their opinions about wellness and disease (Waites, 2009). Older African-Americans will especially opt to use religion as a resource to supplement the psychosocial health issues that they have acquired from the mistrust of the U.S. healthcare system (e.g., Tuskegee Airmen experiments) (Weitzman & Levkoff, 2000). Haley (2013) states that elderly African-Americans are less likely to refuse "life-sustaining treatment" even when quality of life is meager during end-stage. To a greater extent, the social stigma associated with dementia has even kept some older African-Americans from disclosing their dementia status to fellow church members (Weitzman & Levkoff, 2000).

Discussion

Dementia is discussed across a number of academic disciplines ranging from nursing to communication disorders to political science to medical anthropology. However, search results do not yield a formal discussion about the caregiving practices of African-Americans exclusively, and/or in the family context when dealing with dementia. The findings of this study show that older African-Americans living with Alzheimer's disease make up 20% of the United States population; their family caregivers subsequently account for 13% of the population. In other words, the majority of care being provided to African-American adults with dementia, ages 65 and older, are being provided by a member of their family and in a household. The power of "family" and "kinship" is so influential in the African-American community that it is alarming that more academic disciplines continue to overlook its role and construct. Researchers agree that African-Americans and their families are the most affected group by Alzheimer's disease within the United States, so the urgency to help delineate this disorder in this population is crucial. The limitations of this study focused on the lives of elders in lower-income, urban areas rather than rural areas. These findings are not subjective across all African-Americans since this cultural group varies across education level, literacy, and socioeconomic status.

Future Research

Since the home is usually a context for dementia care, it would be beneficial to see if there are ways to improve the household beginning with the family, before outside care providers (e.g. home health aides, geriatric nurses, and speech language pathologists) are brought in. Such incorporation may improve the type of care that these professionals will have to provide, the relationship of the family caregiver-care recipient, and the character of the ill throughout their disease progression (Kleinman, 1976). Accordingly, careful considerations should be given to gender roles in caregiving since research reflects a common caregiver profile, which is a female unwed daughter. This commonality could possibly influence the care for the individual with dementia depending on the prior relationship – a mother-daughter versus father-daughter relationship. So exploring these family roles can be useful in examining if caregiving associations, like burden or uplifts, are increased or decreased depending on the gender roles in the caregiving relationship. Also, the support to the primary caregiver should be examined further, because it can show what type of support is ideal in the home arena for African-Americans with dementia.

Moreover, general clinical measurements would be ideal across cultures for the sake of time efficiency, but the quality of services would present itself not useful if cultural differences are not recognized. The literature shows that caregiving is a traditional value in the African-American community which demonstrates respect and service to the elder kin, who is an important figure. African-Americans either due to socioeconomic status, belief systems, or misdiagnosis are still less likely to seek general medical treatment. Rather, the elders that are deemed demented or display these characteristics are assisted by family members and close friends who have developed a bond that goes beyond that of a professional.

Finally, communication styles of the African-American caregiver-care recipient relationship are important for clinicians to understand. African-Americans have many verbal / non-verbal cues, phrases, and gestures that signify meaningful ideas within their cultural group, communities, and homes. An outsider should first ask these things rather than assume what is normal or abnormal for a dementia patient, out of respect for the patient and their family. General signs are true, but the comorbidity of other health issues, social and environmental factors, often play a major role in the lives of these patients and even their caregivers. Therefore, suggestions for future research include empirical and ethnographic studies based on this critical interpretation.

Conclusion

African-Americans adults, aged 65 years and older, are at higher risks for developing Alzheimer's disease and other related dementia illnesses. In the African-American home context, family caregiving provides an intergenerational and multigenerational support system of caregivers that is an aid in the patient's health care team. Clinicians need to encourage cultural competence by respecting the nature of such intertwined communities.

The lack of research that focuses on this population hinders future professionals and experts alike from truly understanding the importance in difference. Difference does not equate to wrong, but it does require a different way of doing things to ensure the best care possible to all human beings. Starting with the facts, more recruitment efforts, and raising awareness can all be starting points to help this group better understand the disease, how to handle it, what living with

the disorder entails, the prevalence, prevention efforts, and what resources, services, and strategies are available to help them through such a treacherous process.

References

American Psychological Association (n.d.) Retrieved July 16, 2011, from http://www.apa.org/pi/about/publications/caregivers/faq/statistics.aspx

Alzheimer's Association (2003) African-Americans and Alzheimer's disease: The Silent Epidemic, Retrieved from http://www.alz.org/alzheimers_disease_21590.asp, p. 1-7

Ballard, E. Nash, F., Raiford, K., Harrell,L. (1993) Recruitment of Black Elderly for Clinical Research Studies of Dementia: The CERAD Experience. *The Gerontologist* 33:4, 561-565

Belle, S., Burgio, L., Burns, R., Coon, D., Czaja, S., Gallagher-Thompson, D., Gitlin, L., Klinger, J., Koepke, K., Lee, C., Martindale-Adams, J., Nichols, L., Schulz, R., Stahl, S., Stevens, A., Winter, L., Zhang, S. (2006) Enhancing the Quality of Life of Dementia Caregivers from Different Ethnic or Racial Groups. *Ann Intern Med*. 145:727-738

Bookman, A. & Kimbrel, D., (2011) Families and Elder Care in the Twenty-First Century. *The Future of Children*, 21(2), 117-140. Princeton University. Retrieved July 16, 2014, from Project MUSE database.

Briggs, C. (2005) Communicability, Racial Discourse, and Disease. *Annual Review of Anthropology* 34, 269-91.

Cloutterbuck, J. & Mahoney, D. (2003) African American dementia caregivers: The duality of respect. *Sage Publications*, 2:2, 221-243.

Dalstrom, M. (2010) Arthur Kleinman on caregiving. *Somatosphere: Science, Medicine, and Anthropology. Retrieved June 13, 2012*, p. 1-5.

Dilworth-Anderson, P., Williams, I., Gibson, B. (2002) Issues of Race, Ethnicity, and Culture in Caregiving Research: A 20-Year Review (1980–2000). *The Gerontologist*, 42: 2, 237–272

Dunham, C., & Cannon, J. (2008) "They're still in control enough to be in control": Paradox of power in dementia caregiving. Journal of Aging Studies 22 (2008) 45–5

Gallagher-Thompson, D., Haley, W., Guy, D., Rupert, M., Arguelles, T., Zeiss, L, Long, C., Tennstedt, S., Ory, M. (2003) Tailoring Psychological Interventions for Ethnically Diverse Dementia Caregivers. AMERICAN PSYCHOLOGICAL ASSOCIATION*: Clin Psychol Sci Prac* 10: 423–438.

Gaskin, D., LaVeist, T., Richard, P. (2013) The Costs of Alzheimer's and Other Dementia for African Americans. *USAgainstAlzheimer's.*

Haley, W. (2013) Family Caregiving at the End-of-Life: Current Status and Future Directions. *Caregiving Across the Lifespan: Research, Practice, Policy, Caregiving*. New York, NY. pp. 157-171.

Hinton, L., Franz, C., Yeo, G., Levkoff, S. (2005) Conceptions of Dementia in a Multiethnic Sample of Family Caregivers. *Journal of American Geriatrics Society*, 53:1405–1410

Mason-Baughman, M. & Lander, A. (2012) Communication Strategy Training for Caregivers of Individuals With Dementia. *Perspectives on Gerontology. 17:3, 78-83.*

Kleinman, A. (1976) Concepts and a Model for the Comparison of Medical Systems as Cultural Systems. *Soc. Sci. & Med*. 12:85-93.

Kleinman, A. (2008). The art of medicine - Catastrophe and caregiving: the failure of medicine as an art. *Perspectives* 371, 22-23.

Kleinman, A (2009). The art of medicine - Caregiving: the odyssey of becoming more human. *Perspectives*, 373, 292-293.

Kleinman, A. & van der Geest, S. (2009) 'Care' in health care: Remaking the moral world of medicine. *MEDISCHE ANTROPOLOGIE* 21 (1)

Lawton, M., Rajagopal,D., Brody, E., Kleban, M. (1992) The Dynamics of Caregiving for a Demented Elder Among Black and White Families. *Gerontology:* 47: 4, 5156-5164.

Naue, U. & Kroll, T., (2008) 'The demented other': identity and difference in dementia. *Blackwell Publishing Ltd Nursing Philosophy*, 10, pp. 26–33

Ripich, D., Carpenter, B., Ziol, E. (1997) Comparison of African-American and white persons with Alzheimer's disease on language measures; *NEUROLOGY* 48:781-783

Rovner, B., Casten, R., Harris, L. (2013) Cultural Diversity and Views on Alzheimer Disease in Older African Americans. *Alzheimer Dis Assoc Disord*, 27:133–137

Waites, C. (2009) Building on Strengths: Intergenerational Practice with African American Families. *Social Work*, 54 (3): 278-287.

Watson, B., Aizawa, L., Savundranayagam, M., Orange, J. (2013) Links Among Communication, Dementia and Caregiver Burden. *Canadian Journal of Speech-Language Pathology and Audiology.* 36:4

Weitzman, P. & Levkoff, S. (2000) Combining Qualitative and Quantitative Methods in Health Research with Minority Elders: Lessons from a Study of Dementia Caregiving. *Field Methods* 2000 12:195. Sage Publications

White, K. (2009) An Introduction to the Sociology of Health and Illness. *Sage Publications.* London, England. pp. 1-45.

Are Interpersonal Strengths Associated with Academic Achievement and Interests?

Carolina A. Ribo, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Aaron L. Pincus, Ph.D
Professor of Psychology
Department of Psychology
College of the Liberal Arts
The Pennsylvania State University

Abstract

This study examined the associations between interpersonal strengths and academic achievements and interests in a sample of 248 university students. Interpersonal strengths were assessed by the Inventory of Interpersonal Strengths (IIS), which conforms to the two-dimensional interpersonal circumplex (IPC) model of personality. Academic achievement indexed by high school GPA and SAT scores and college GPA, were correlated with the agentic (dominant—submissive) and communal (warm—cold) dimensions of interpersonal strength. Academic interests were indexed by the student's current major. Students were classified into one of four interpersonal types based on the level of their agentic and communal interpersonal strengths (Warm-Dominant; Cold-Dominant; Cold-Submissive; Warm-Submissive). Chi-square analyses were conducted to examine the distribution of student majors as a function of interpersonal strength classification.

Introduction

Young peoples' lives are constantly changing as they balance their time between school, work, family, and friends. These stressors, combined with the actual experience of attending college, negatively affect many students. Topics such as college attrition and retention rates, depression among college students, socio-economic diversity, and on-campus culture tend to dominate studies about this demographic (Freeman et. al, 2007; Wothington, & Higgs, 2003; Lackland, & Lisi, 2001). Although focusing on the ways in which college students experience stress may benefit education policy and programming designed to resolve this issue, few studies investigate how student ability relates to interpersonal strengths. Previous research has validated the importance of interpersonal relationships and self-efficacy in young peoples' lives (Martin & Dowson, 2009; Picou & Curry, 1973; Anderman & Anderman, 1999; Freeman & Anderman, 2007; Sayeed & Jain, 2000; Farsides & Woodfield, 2003; Bong, 2001). Having good interpersonal relationships gives an individual the tools to obtain assistance with tasks and challenges, receive emotional support, and experience companionship in shared activities (Martin & Dowson, 2009). Having a sense of self-efficacy gives the individual the capability to manage academic tasks and goals, and also the ability to better handle stress, anxiety and depression (Zimmerman, 2000). In the current study, both relational ability and self-efficacy are considered interpersonal strengths.

This study considers how interpersonal strengths influence college students' academic achievement and major selection. It is important to know what interpersonal factors contribute to a students' academic achievement and selection of major for at least two reasons. First, this can help student's recognize what their interpersonal strengths are, and how to best utilize their interpersonal strengths to help achieve their full potential in the college setting. This may lessen depression and student attrition rate in college students because they can select majors that best fit their interpersonal strengths. Second, this may also help Universities, as they lose money due to college students dropping out.

Gerdes and Mallinckrod (1994) found that students underestimate how difficult it is to adjust to the college environment. Individuals who had dropped out were not sure about their own academic goals, and reported to be more stressed and anxious. However, the researchers also indicated that interventions that incorporated both social and academic skills contribute to student's retention. This can give universities the tools to help their students decide which major they should pursue, and help the students achieve their full potential. Astin (1977) found that, "When we compare individual students' high school grades and college grades, we find that about one in three obtains the same grades in college as in high school, only about one in five obtain higher grades, and nearly half obtain lower grades." It is no surprise that students earn lower grades in college than they did in high school. This could be attributed to a number of factors such as classroom size and attention from faculty, stress and adjusting to the university.

Self-efficacy is also a construct that is related to student's academic success. In fact, self-efficacy has not only been correlated with academic achievement, but it is also correlated with academic choices, changes, and with other self-beliefs (Pajares, 1996). Other studies have supported these findings that self-efficacy is an important predictor of the selection of major and career (Shunk, 1989). To demonstrate how important self-efficacy is in the academic setting, not only for major selection but for achievement, (Lent et. al., 1984, 1986) study found that individuals who major in science and engineering demonstrated high self-efficacy that

influenced the students determination that is needed to uphold high academic achievement. In all, researchers have found that self-efficacy beliefs give students a sense of agency to strategize, set goals, self-monitor, and self-evaluate to improve their academic success (Zimmerman, 2000).

Examining interpersonal relationships, self-efficacy, and major selection could better helps students transition into college by fitting them with a major that best suits their interpersonal strengths, personality, and goals.

Personality, Social Functioning, Self-Efficacy, and Academic Achievement

Many studies identify personality as one of the major factors influencing the formation of interpersonal relationships (McCrae, & Costa, 1989). Personality studies using the five-factor model of personality traits demonstrate a positive relationship between students who are higher in trait Agreeableness and their academic achievement. Agreeableness is expressed as characteristics such as being sociable, even-tempered, warm, caring, receptive, and dependable (Judge & Bono, 2000; Mount et al., 1998). Farsides and Woodfields (2003) found that Agreeableness was positively correlated with better attendance at seminars and higher academic achievement. Thus, the more agreeable students scored higher on their final grades, in part due to the fact that they were less likely to skip seminars. The study also found that students who were quite high in Agreeableness might flourish when the teaching and assessment occurs through collective interaction. In other words, students who are high in Agreeableness work best in-group settings where they are able to share ideas. In contrast, students who are lower in Agreeableness work best in academic settings where students are less inclined to work together (Farsides, & Woodfield, 2003).

Consistent with results for Agreeableness, studies have also examined social functioning and academic achievement. Freeman, Anderman, and Jensen (2007), found that elementary school students' sense of community was positively associated with their academic motivation. Additionally, in a sample of middle school students, they found a positive relationship between students' perceptions of belonging and a broad measure of academic motivations (Freeman et. al, 2007). The study showed that the more an individual feels as if they belong to a peer group, they are more likely to have higher achievement motivation. An earlier study by Anderman and Anderman (1997) yielded similar results. They found increased focus on academic tasks was associated with the sense of psychological belonging in school and the support of social responsibility goals (i.e., adherence to social rules and expectations). In contrast, those who did not endorse social responsibility roles, but only social goals (i.e., individuals for whom peer relationships and status are especially salient) were more self-focused and relied more on the peer group for evidence of their own academic success (Anderman, & Anderman, 1997). That is, the individuals who sought out friendships to maintain status did not care as much about their academics as the individuals who endorsed social responsibility goals.

In addition to Agreeableness and social functioning, self-efficacy also has an impact on student's academic achievement. Albert Bandura defines self-efficacy as, "…judgments of how well one can execute courses of action required to deal with prospective situations" (p. 122). There have been many studies that examine the effect of self-efficacy on a student's grades, motivation, and academic performance (Wood, & Locke, 1987). Individuals with low self-efficacy may avoid tasks that they see as challenging, and individuals with high-self efficacy will embrace task challenges (Bandura, 1977; Weiner, 1979). Zimmerman (2000) found that students who are self-efficacious work harder, persist longer, and have less negative emotional reactions than those who are less self-efficacious. He also suggested that student's belief in self-efficacy

could also emotionally influence them and decrease stress, anxiety, and depression when managing academic responsibilities. Also, when a student believes that they can successfully accomplish all of the educational requirements that are associated with the career in that major, they are more likely to choose that career than students who doubt their competence (Schunk, 1989). When an individual develops good interpersonal relationships and has a high sense of self-efficacy they are more likely to succeed in their academics and maintain a support system. However, when individuals do not have good interpersonal relationships or has low self-efficacy, there can be negative effects not only on the individual's academic achievement, but also their psychological well-being. For example, one study found that when an individual fails to form satisfactory interpersonal relationships in college it is correlated with depression, anxiety, suicide, criminality, and freshman attrition (Freeman et al., 2007).

Another important negative trait that stems from not having good interpersonal relationships and low self-efficacy, is the tendency to experience greater stress (Baumeister, & Leary, 1995). This could be because individuals who do not have stable interpersonal relationships do not receive assistance for coping and a buffer against stress (Baumeister, & Leary, 1995) and yet simultaneously do not feel up to the challenges of life (Bandura, 1977). Thus, the lack of interpersonal relationships and low self-efficacy can have a negative affect on individuals both psychologically and physically. With evidence supporting such, one can see how these negative affects may be able to carry on to impact an individual's academic life and impact them negatively.

Given the evidence reviewed, it is important to study how interpersonal relationships and self-efficacy can affect an individual in an academic setting. First, in college students, interpersonal functioning could affect the student's grades and their choice of major, depending on their particular goals and worries. Second, individuals may be more motivated and more engaged in the academic setting if individuals have good interpersonal relationships and a sense of belonging.

Social Functioning, Personality, and Academic Interests

This study will also look at the choice of major and interpersonal strengths. There are many factors that contribute to a student's choice of major such as gender and racial segregation, traditional gender roles, academic ability, and personality (Umbach, & Porter, 2006; Lackland, & Lisi, 2001; Austin, 1993). There has been a considerable amount of research examining associations between choice of major and personality traits. The most prominent theory of personality and major choice is Holland's theory of careers (Porter & Umbach, 2006). Holland's theory proposes that individuals select their major based not only on academic interests, but also based on the ability to covey their capabilities, talents, points of view and beliefs in that particular major (Brown, 2002). Based on this assumption, Holland has developed six representative environments that tell us which personality traits fit which majors. These environments consist of realistic (electrical engineering, mechanical engineering), investigative (biology, math, economics, sociology), social (political science, nursing, philosophy), enterprise (business, communications, computer science), artistic (English, architecture), and conventional (accounting) (Porter, & Umbach, 2006). A student's interpersonal relationships, preferences for social functioning, and self-efficacy are likely to be associated with which major environments (Brown, 2002).

Hackett and Betz (1981), has suggested that self-efficacy can help predict an individuals career options. This is predicted by the students self-efficacy for learning or performing the

various tasks that are related to the job (Hackett & Betz, 1981). More recent studies have validated this theory. Zimmerman (2000) found a strong correlation between a student's measure of self-efficacy and major selection in college. The relationship between self-efficacy and choice of major or career could be in part because individuals who are self-efficacious are more likely to persist longer and are more likely to greatly increase their ability to achieve their goals when they perceive that the extra effort will produce an outcome that they see as favorable (Weiner, 1979).

An Interpersonal Lens: Agency and Communion

In this study, I use the Interpersonal Circumplex (IPC) model of personality (Pincus & Ansell, 2013) as a lens to examine social functioning, self-efficacy, academic achievement, and academic interest. Freedman et al. (1951) were the first to publish about an interpersonal system of personality diagnosis. Their work continues to influence contemporary research about this subject because it established a standardized method for operationally defining interpersonal variables through personality traits. (Freedman et. al., 1951). Other researchers drew on Freedman et al.'s methodology and continued to develop an empirically based interpersonal system of personality diagnosis (see Leary, 1957; Chance, 1959; Benjamin, 1973; Wiggins, 1979).

In a seminal review and integration of the interpersonal nature and relevance of Bakan's (1966) metaconcepts of "agency" and "communion," Wiggins (1991, 1997a, 2003) argued that these two superordinate dimensions have propaedeutic explanatory power across scientific disciplines. "Agency" refers to the condition of being a differentiated, and self-efficacious individual, and it is manifested in strivings for power and mastery, which can enhance and protect one's differentiation. "Communion" refers to the condition of being part of a larger social or spiritual entity, and is manifested in strivings for intimacy, union, and solidarity with the larger entity. Bakan (1966) noted that a key issue for understanding human existence is to comprehend how the tensions of this duality in our condition are managed. Wiggins (2003) proposed that agency and communion are most directly related to Sullivan's theory in terms of the goals of human relationship: security (communion) and self-esteem (agency). As can be seen in Figure 1 these metaconcepts form a superordinate structure used to derive explanatory and descriptive concepts at different levels of specificity. At the broadest and most interdisciplinary level, agency and communion classify the interpersonal motives, strivings, and values of human relations (Horowitz, 2004). In interpersonal situations, motivation can reflect the agentic and communal nature of the individual's personal strivings or current concerns, or more specific agentic and communal goals (e.g., to be in control; to be close) that specific behaviors are enacted to achieve (Grosse Holtforth, Thomas, & Caspar, 2010; Horowitz et al, 2006).

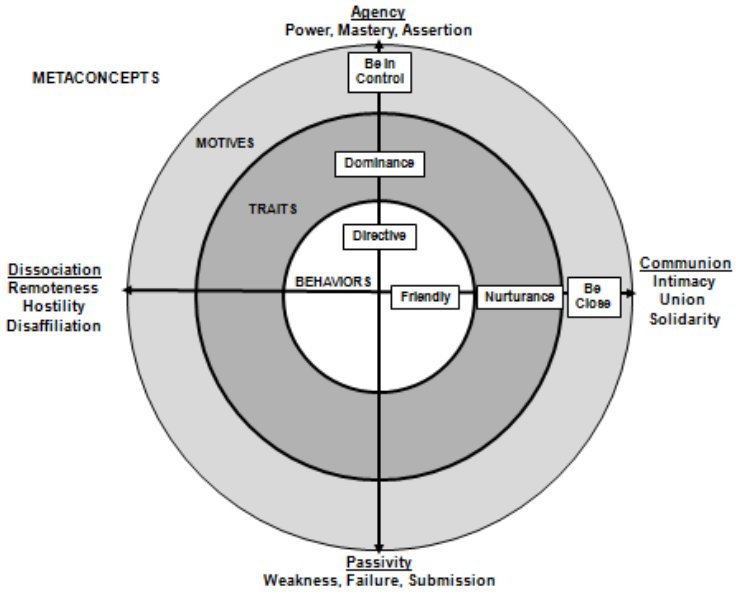


Figure 1: Agency and Communion

At more specific levels, the structure provides conceptual coordinates for describing and measuring interpersonal dispositions and behaviors (Wiggins, 1991). The intermediate level of dispositions includes an evolving set of interpersonal constructs (Hopwood et al., 2011; Locke, 2006, 2010). Agentic and communal dispositions imply enduring patterns of perceiving, thinking, feeling, and behaving that are probabilistic in nature, and describe an individual's interpersonal tendencies aggregated across time, place, and relationships. At the most specific level, the structure can be used to classify the nature and intensity of specific interpersonal behaviors (Moskowitz, 1994, 2005, 2009). Wiggins' theoretical analysis simultaneously allows for the integration of descriptive levels within the interpersonal tradition as well as expansion of the conceptual scope and meaning of interpersonal functioning. Contemporary interpersonal theory proposes that (a) agency and communion are fundamental metaconcepts of personality, providing a superordinate structure for conceptualizing interpersonal situations; (b) explicatory systems derived from agency and communion can be used to understand, describe, and measure interpersonal motives, dispositions, and behaviors; and (c) such systems can be applied equally well to the objective description of contemporaneous interactions between two or more people (e.g., Sadler, Ethier, Gunn, Duoung, & Woody, 2009) and to interpersonal situations within the mind evoked via perception, memory, fantasy, and mental representation (e.g. Lukowitsky & Pincus, 2011).

The emphasis on interpersonal functioning in Sullivan's work led to efforts to develop orderly and lawful conceptual and empirical models describing interpersonal behavior (for reviews of these developments, see LaForge, 2004; LaForge, Freedman, & Wiggins, 1985; Leary, 1957; Pincus, 1994; Wiggins, 1982, 1996). The goal of such work was to obtain an interpersonal taxonomy of dispositions and behaviors, that is, "to obtain categories of increasing generality that permit description of behaviors according to their natural relationships" (Schaefer, 1961, p. 126). In contemporary terms, these systems are referred to as structural models, which can be used to conceptually systematize observation and covariation of variables of interest. When seen in relation to the metaconcepts of agency and communion, such models become part of an illuminating nomological net.

Empirical research into diverse interpersonal taxa including traits (Wiggins, 1979), problems (Alden, Wiggins, & Pincus, 1990); sensitivities (Hopwood et al., 2011), values (Locke,

2000), impact messages (Kiesler, Schmidt, & Wagner, 1997), strengths (Hatcher & Rogers, 2009), efficacies (Locke & Sadler, 2007), and behaviors (Benjamin, 1974, 2010; Di Blas, Grassi, Luccio, & Momenté, in press; Gifford, 1991; Moskowitz, 1994; Trobst, 2000) converge in suggesting the structure of interpersonal functioning takes the form of a circle or "circumplex" (Gurtman & Pincus, 2000; Wiggins & Trobst, 1997). An exemplar of this form based on the two underlying dimensions of dominance-submission (agency) on the vertical axis and nurturance-coldness (communion) on the horizontal axis is the most common instantiation of the IPC (see Figure 2). The geometric properties of circumplex models give rise to unique computational methods for assessment and research (Gurtman & Balakrishnan, 1998; Gurtman & Pincus, 2003; Wright, Pincus, Conroy, & Hilsenroth, 2009). Blends of dominance and nurturance can be located along the 360-degree perimeter of the circle. Interpersonal qualities close to one another on the perimeter are conceptually and statistically similar, qualities at 90 degrees are conceptually and statistically independent, and qualities 180 degrees apart are conceptual and statistical opposites. Although the circular model itself is a continuum without beginning or end (Carson, 1996; Gurtman & Pincus, 2000), any segmentalization of the IPC perimeter to identify lower-order taxa is potentially useful within the limits of reliable discriminability. The IPC has been segmentalized into sixteenths (Kiesler, 1983), most commonly octants (Wiggins, Trapnell, & Phillips, 1988), and quadrants (Carson, 1969).

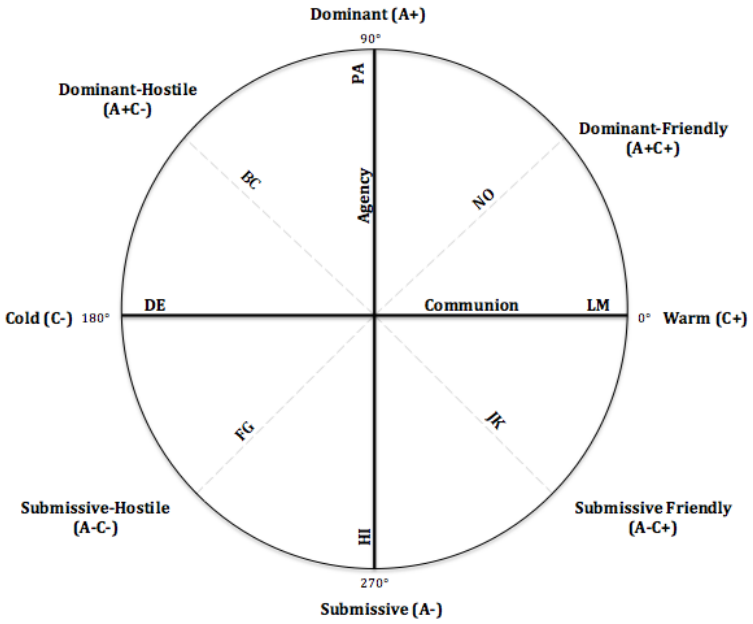


Figure 2: Interpersonal Circumplex

Intermediate-level structural models derived from agency and communion focus on the description of the individual's interpersonal dispositions that, when understood in relation to their motives and goals, are assumed to give rise to adaptive and maladaptive behavior that is generally consistent across interpersonal situations (Horowitz & Wilson, 2005; Wiggins, 1997b). Thus, we can use circumplex models to describe a person's typical ways of relating to others and refer to their interpersonal style or theme. Using IPC models to classify individuals in terms of their agentic and communal characteristics is often referred to as "interpersonal diagnosis"

(Pincus & Wright, 2010; Wiggins, Phillips, & Trapnell, 1989). In this study, I use the IPC to classify participants into distinct categories of interpersonal style.

Students will be classified into one of four categories of predominant Interpersonal style based on their responses to the Inventory of Interpersonal Strengths (Hatcher & Rogers, 2012). These categories consist of dominant-friendly (A+C+), dominant-cold (A+C-), submissive-cold (A-C-), and submissive-friendly (A-C+).

Inventory of Interpersonal Strengths (IIS)

The inventory of interpersonal strengths, the IIS-32, was used to collect data from the individuals who participated in the study. This inventory encompasses positive interpersonal qualities across all areas of the interpersonal circle (Hatcher, & Rogers, 2012). Hatcher and Rogers (2009) define strengths as, "Interpersonal features that contribute to interpersonal competence, emotional stability, fewer interpersonal problems, and better relationship outcomes, among other positive indicators." The inventory is unique in that it also measures the strengths associated with low communion octants on the left side of the circle that traditionally have been considered more negative (Hatcher & Rogers, 2009).

Current Study

The current study examined the associations between interpersonal strengths and academic achievement (high school and college GPA, SAT scores) and academic interest (major, academic college) in undergraduate students. Based on their IIS scores, students were classified into one of four interpersonal strength groups (A+, C+; A+C-; A-,C-; A-C+). The study examined whether academic achievement and interests were associated with particular interpersonal strengths.

Hypotheses

The previous research has shown that a students' interpersonal situation can have a positive or negative effect on a students' achievement. Based on the literature, this study will utilize participants SAT scores and high school and college GPAs. It is proposed that communal strengths associated with effective relating and agentic strengths associated with self-efficacy and striving will both correlate positively with indicators of academic achievement (high school GPA, SAT score, college GPA).

The previous literature has shown that there are strong correlations between personality traits and choice of college major. As previously stated, Holland's Theory of Careers proposes that a students' social functioning preferences are likely to be associated with major environments that they find more attractive. According to Holland's theory, individuals who choose certain environments (e.g. realistic, investigative, artistic, social, and enterprising) will have personality traits that coincide with the environment (Brown, 2002). However, individuals may share traits from more than one environment (Brown, 2002). According to this theory, individuals in the six environments will exhibit some of the following traits: Individuals who are categorized in the *Realistic* environment have traits such as hard-headed, quite, and reserved; individuals who are categorized in the *Investigative* environment exhibit traits such as analytical, mechanical, and precise; individual's who are categorized in the *Artistic* environment exhibit traits such as power-seeking, non-conforming, and radical; individuals who are categorized in the *Social* environment exhibit traits such as friendly, sociable, and sincere; individuals who are categorized in the *Enterprising* environment exhibit traits such as aggression, dominance, and

power-seeking; last, individuals who are categorized in the *Conventional* environment exhibit traits such as shrewd, conforming, and rebellious (Brown, 2002). From Holland's theory, several hypotheses are predicted (Table 1):

- *H1*: It is predicted that individuals whose majors are in the *Social* and *Conventional* environment will both be high in agency and high in communion (A+C+).
- *H2*: Individuals whose majors are in the *Enterprising* environment are predicted to score high in Agency (A+).
- *H3*: Individuals whose majors are in the environments *Realistic, Investigative, and Artistic* are predicted to both score high in agency and low in communion (A+C-).
- *H4*: It is predicted that individuals who are undecided about their major (division of undergraduate studies) will be low in agency and high in communion (A-C+).

Table 1: Holland's Theory of Careers

Environment	Major	Hypotheses
Realistic: Disciplines that, "…focus on concrete practical activities that often use machines or tools" (Porter, & Umbach, 2006).	Electrical Engineering Mechanical Engineering Information Science and Technology Security Risk Analysis Chemical Engineering	It is predicted that individuals whose major is in the *Realistic* environment will score high in agency and low in communion (A+C).
Investigative: Disciplines that, "… the acquisition of knowledge through investigation and problem solving" (Porter, & Umbach, 2006).	Biology Math Sociology Forensic Science Bio behavioral health Civil Engineering Kinesiology Chemistry Meteorology Biochemistry and Molecular Biology Earth and Mineral Science Veterinary and Biomedical Science Animal Science	It is predicted that individuals whose major is in the *Investigative* environment will score high in agency and low in communion (A+C-).
Social: Disciplines that, "…emphasize the acquisition of interpersonal competencies" (Porter, & Umbach, 2006).	Political Science Nursing Education Human Development and Family Studies Rehabilitation and Human Services Criminology Philosophy Pre-Med Athletic Training Nutrition Health and Policy Administration Communication Sciences and Disorders	It is predicted that individuals whose major is in the *Social* environment will be high in agency and high in communion (A+C+).
Enterprising: Disciplines that,"… emphasize leadership development and reward popularity, self-confidence and aggressiveness" (Porter, & Umbach, 2006).	Marketing Labor Employment and Relations Public Relations Hotel, Restaurant, and Institution Management Management Hospitality Management Advertising Computer Science Communication	It is predicted that individuals whose major is in the Enterprising environment will score high in Agency (A+).
Artistic: Disciplines that, "… encourage the acquisition of innovative and creative competencies" (Porter, & Umbach, 2006).	Art Architecture	It is predicted that individuals whose major is in the *Artistic* environment will score high in agency and low in communion (A+C-).
Conventional: Disciplines that, "… emphasize a conventional outlook and are concerned with orderliness and routines" (Porter, & Umbach, 2006).	Accounting Economics Finance	It is predicted that individuals whose major is in the *Conventional* environment be high in agency and high in communion (A+C+).

Methods

Participants

This study used previously collected data for analysis. The sample consists of a total of 248 college students (126 men, 122 women) from a large public university. The mean age of the participants was 19.3 years (*SD* = 1.41).

Measures

Participant's academic achievement was assessed with multiple measures (high school GPA [0-4], college GPA [0-4], and SAT scores (0-2400). Academic interests were assessed by the students' declared major.

Majors categorized into specific environments according to Holland's Theory of Careers. These environments consist of *Realistic* (which included electrical engineering, mechanical engineering, information science and technology, security and risk analysis, and chemical engineering), *Investigative* (which included biology, math, forensic science, bio behavioral health, sociology, economics, civil engineering, kinesiology, chemistry, meteorology, biochemistry and molecular biology, earth and mineral sciences, veterinary and biomedical science, and animal science), *Social* (which include political science, nursing, education, philosophy, human development and family studies, rehabilitation and human services, criminology, pre-med, athletic training, nutrition, health and policy administration, communication sciences and disorders (speech pathology), and animal science), *Enterprising* (which include marketing, labor employment and relations, public relations, hotel, restaurant, and hospitality management, management, hospitality management, advertising, computer science, communication, journalism, and supply chain management), *Environment* (which include art and architecture), and *Conventional* (which included accounting, economics and finance). Holland's Theory fails to acknowledge undecided major and so The *Division of Undergraduate Studies* (undeclared majors) was not categorized into any environments and was not used in this study.

Interpersonal strengths were assessed using the abbreviated version of Inventory of Interpersonal Strengths (IIS-32; Hather & Rogers, 2012). The IIS consists of eight octants (Dominant, Extraverted, Warm, Unassuming, Submissive, Introverted, Cold, and Arrogant), which measure an individual's positive interpersonal characteristics. Based on their IIS scores, participant's will be classified into one of 4 interpersonal styles based on the quadrants of the IPC reflecting their blend of agentic and communional strengths.

Analyses

The association between interpersonal strength classification and academic achievement will be examined in two ways. First, the 3 continuous scores for SAT, high school GPA, and college GPA will be correlated with participant scores on agentic and communal strengths. Second, these same indicators of academic achievement will be compared across the 4 groups of students classified by their predominant interpersonal strengths. Analysis of variance will be used to examine mean differences in GPAs and SAT scores across groups.

Because college major is a categorical rather than a continuous variable, a Chi-Squared statistical analysis will be used to determine the relationship between interpersonal strength classification and academic interests via major and college. This analysis evaluates whether

majors are distributed randomly across the 4 groups of students classified by their predominant interpersonal strengths or exhibit specific associations with particular interpersonal strengths.

Results

In order to examine the relationship between high school GPA, college GPA, and SAT scores, and agentic and communal strengths, a one-tailed Pearson's Correlation Coefficient was computed between variables (Table 2). As expected, the results yielded a positive correlation between high school GPA and agentic strengths (r = .12, p = .030) but, unexpectedly, there was no correlation between high school GPA and communal strengths. Inconsistent with hypotheses, college GPA did not correlate with agentic or communal strengths. Finally, as hypothesized, SAT scores were positively correlated with both agentic (r = .22, p = .000) and communal (r = .11, p = .050) strengths.

		DOM1_IIS	LOV1_IIS
GPAhs	Pearson Correlation	.12*	.06
	Sig. (1-tailed)	.030*	.182
	N	245	245
GPAcollege	Pearson Correlation	.07	.06
	Sig. (1-tailed)	.204	.240
	N	128	128
SAT	Pearson Correlation	.22**	.11*
	Sig. (1-tailed)	.000*	.050*
	N	237	237

Table 2. Correlations
*. Correlation is significant at the 0.05 level (1-tailed).
**. Correlation is significant at the 0.01 level (1-tailed).

Majors were categorized into Holland's Theory of Career environments. Each separate major was categorized into one of six environments *Realistic* (N=24), *Investigative* (N = 53), *Social* (N=108), *Enterprising* (N= 17), *Artistic* (N = 3), and *Conventional* (N = 9). A contingency table was created to summarize the categorical data (Table 3). The contingency table consists of the six Holland environments (rows) and the four interpersonal circumplex quadrants (columns). The table shows the amount of individuals in a specific quadrant when separated by environment. Within the rows, percentages are given of how many individuals are in one of the four quadrants within the specific environment and what percentage the group makes up within the quadrant. A Chi-Square test of independence was performed to investigate the relationship between major and the four interpersonal circumplex quadrants (Dominant-Friendly, Dominant-Hostile, Hostile-Submissive, and Friendly- Submissive). The relationship between major and the four IPC four quadrants was not significant, X^2 (15; N = 214) = 7.024, P > .05 (see Table 4).

Holl_NewMajor * Quadrant Crosstabulation

			Quadrant				Total
			Dominant-Friendly	Dominant-Hostile	Hostile-Submissive	Friendly-Submissive	
Holl_NewMajor	Realistic	Count	10	12	1	1	24
		% within Holl_NewMajor	41.7%	50.0%	4.2%	4.2%	100.0%
		% within Quadrant	16.9%	9.0%	6.7%	16.7%	11.2%
		% of Total	4.7%	5.6%	0.5%	0.5%	11.2%
	Investigative	Count	12	33	6	2	53
		% within Holl_NewMajor	22.6%	62.3%	11.3%	3.8%	100.0%
		% within Quadrant	20.3%	24.6%	40.0%	33.3%	24.8%
		% of Total	5.6%	15.4%	2.8%	0.9%	24.8%
	Social	Count	29	70	6	3	108
		% within Holl_NewMajor	26.9%	64.8%	5.6%	2.8%	100.0%
		% within Quadrant	49.2%	52.2%	40.0%	50.0%	50.5%
		% of Total	13.6%	32.7%	2.8%	1.4%	50.5%
	Enterprise	Count	4	12	1	0	17
		% within Holl_NewMajor	23.5%	70.6%	5.9%	0.0%	100.0%
		% within Quadrant	6.8%	9.0%	6.7%	0.0%	7.9%
		% of Total	1.9%	5.6%	0.5%	0.0%	7.9%
	Artistic	Count	1	2	0	0	3
		% within Holl_NewMajor	33.3%	66.7%	0.0%	0.0%	100.0%
		% within Quadrant	1.7%	1.5%	0.0%	0.0%	1.4%
		% of Total	0.5%	0.9%	0.0%	0.0%	1.4%
	Conventional	Count	3	5	1	0	9
		% within Holl_NewMajor	33.3%	55.6%	11.1%	0.0%	100.0%
		% within Quadrant	5.1%	3.7%	6.7%	0.0%	4.2%
		% of Total	1.4%	2.3%	0.5%	0.0%	4.2%
Total		Count	59	134	15	6	214
		% within Holl_NewMajor	27.6%	62.6%	7.0%	2.8%	100.0%
		% within Quadrant	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	27.6%	62.6%	7.0%	2.8%	100.0%

Table 3: Contingency table displaying Holland's environments and IPC quadrants.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.024[a]	15	.957
Likelihood Ratio	7.658	15	.937
Linear-by-Linear Association	.064	1	.801
N of Valid Cases	214		

Table 4. Chi-Square Tests

Three hypotheses regarding academic achievement and interpersonal strengths were supported. First, high school GPA was positively correlated with agentic strengths (r = .12, p = .030), and SAT scores were positively correlated with both agentic (r = .22, p = .000) and communal (r = .11, p = .050) strengths. However, I did not find an expected correlation between high school GPA communal strengths, nor was college GPA correlated with dimensions of interpersonal strength. Hypotheses regarding academic interests and interpersonal strengths were not supported.

Discussion

The present study aimed at identifying if interpersonal strengths are associated with academic achievements and interests. Hypothesis regarding interpersonal achievement in relation to interpersonal strengths were supported. However, hypotheses regarding academic interests and interpersonal strengths were not supported. The present findings provide several important conclusions. First, there was a positive correlation between high school GPA and Agentic strengths, and between SAT scores and Agentic and Communal strengths, indicating that being able to connect with others (communal strengths) and direct oneself (agentic strengths) promote better academic achievement, at least in high school. The unexpected failure of college GPA to correlate with interpersonal strengths may be due to a lack of reliability. Most participants were in their first or second semester at university, thus almost half (N = 117) had no college GPA to report and the participants who did provide one (N = 128) were typically reporting their GPA for their first semester at university. First semester college GPAs may not be a reliable predictor of academic success.

With regard to academic interests, the present findings found no relationship between chosen majors and the four interpersonal circumplex quadrants (Dominant-Friendly, Dominant-Hostile, Hostile-Submissive, and Friendly- Submissive). One possible reason that there was no relationship found between these two variables is that there were not many individuals in certain major environments. For example, there were only three individuals in the *artistic* environment, and only 9 individuals in the *conventional* environment as opposed to 108 individuals in the *Social* environment. This could contribute to their not being enough people in certain majors to show an effect. Therefore, a larger sample size should be used to see if there may be an effect. Another possible reason for this lack of association again lies with the first-year status of the majority of participants. Although most identified a declared major, it is possible that it does not represent their ultimate choice and will change over time, as it is common to switch majors in college. Associations between major at the time of graduation and interpersonal strengths might be stronger than the major selected in the first year at university.

Overall, the findings for academic achievement are quite consistent with previous studies that identified good social relationships, a sense of belonging, and higher levels of Agreeableness (i.e., communal strengths), as well as self-efficacy (i.e., agentic strengths) as significantly related to higher academic motivation and achievement (e.g., Farsides & Woodfields, 2003; Freeman et al., 2007; Zimmerman, 2000).

Findings for major selection were not consistent with the past literature. The previous literature suggested that individuals choose majors that are consistent with their personality and that can adequately convey their capabilities. However, my findings suggest there is no association between choice of major and interpersonal strengths or social functioning preferences.

Limitations and Future Directions

There are some limitations to this study that need to be addressed. First, it is important to note that the data used was self-report. This could reflect a response bias on the part of the participant. Second, this study looked at first and second semester college students. This presents a problem when individuals were asked to report their college GPA. Many students did not report their GPA because they may not have had one at the time. Also, first year college GPA as a predictor of academic success may not be reliable due to the fact that many students are adjusting to university life and their initial grades may not be representative of their overall undergraduate performance. Third, the study only took into consideration a student's major; this study did not take into consideration an individual's minor or if they double majored. If a student was a double major the first major listed was the one that was selected for data analysis. Also, as previously stated individuals tend to switch majors during their college career and the current data may not accurately represent the student's ultimate choice of major. Fourth, as previously stated the sample size did not sufficiently represent all environments in Holland's theory of careers. Some of the environments had a large amount of student's (as many as 108) and a very small amount of students (as little as 3). Last, this study did not take into consideration of the individuals whose major was undeclared. Individuals whose major is major is undeclared should be examined in future studies as these individuals may show different interpersonal traits than those who have a declared major (e.g., engineering, psychology).

Despite these limitations this study shows that there is a relationship between self-report measures of interpersonal strengths and objective measures of academic achievement such as high school GPA and SAT scores. This is important for several reasons. First, college admissions can use the information to help students who are struggling with their academics. By using the Inventory of Interpersonal Strengths, colleges can determine what would help students best succeed and implement programs designed to help the individuals who are struggling. This may also help the students who are doing well stay on track. Having this could help reduce a student's stress and worry, especially in their first year of college when most of the adjustment occurs. This could help reduce attrition rates, and raise retention rates for colleges. This could also possibly lower student's depression and help students make the transition to a University setting less stressful. Third, this study shows an interesting correlation between objective measures and self-report.

Future directions of this study should include surveying students who are seniors in college. By doing so a more accurate college GPA is likely to be reported and it will also reflect what major the individual ultimately chooses and will graduate with. A larger sample would also be desirable for this study. Future studies may want to take into consideration student's double

major and minors. Perhaps this may show differences in agentic and communal strengths between those who double major or have a minor and individuals who only have one major. The relationship between interpersonal strengths and major selection warrants more attention. Larger samples of graduating seniors may show that there is in fact a relationship between interpersonal strengths and academic interest. Future research could greatly improve a student's college experience. Using the Inventory of Interpersonal Strengths and traits that are consistently associated with certain majors, admissions may be able to make suggestions to the student about which major may be most suitable for them. This could prevent a loss of time switching majors, and may also prevent students from dropping out since they may be matched with a major that best suits them.

References

Alden, L. E., Wiggins, J. S., & Pincus, A .L. (1990). Construction of circumplex scales of the Inventory of Interpersonal Problems. *Journal of Personality Assessment, 55,* 521-536.

Anderman, L.H., & Andereman, E.M (1999). Social predictors of changes in students' achievement goal orientations. *Contemporary Educational Psychology, 25,* 21-37.

Astin, A. W. (1977). Four Critical Years. San Francisco: Jossey-Bass.

Bakan, D. (1966). *The duality of human existence: Isolation and communion in Western man*. Beacon Press (MA).

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37,* 122-147.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117,* 497-529.

Benjamin, L. S. (2010). Structural analysis of social behavior: Studying the nature of nature. In L. M. Horowitz and S. Strack (Eds.), *Handbook of interpersonal psychology* (pp. 325-342). Hoboken, NJ: Wiley.

Benjamin, L. S. (1974). Structural analysis of social behavior. *Psychological Review, 81,* 392-425.

Benjamin, L. S. (1973). A biological model for understanding the behavior of individuals. In J. Westman (Ed.), *Individual differences in children*. New York: Wiley.

Bong, M. (2001). Role of self-efficacy and task value in predicting college students course performance and future enrollment intentions. *Contemporary Educational Psychology, 26,* 553-570.

Carson, R. C. (1969). *Interaction concepts of personality*. Chicago: Aldine Publishing Co.

Carson, R. C. (1996). Seamless in personality and its derangements. *Journal of Personality Assessment, 66,* 240-247.

Chance, E. (1959). *Families in treatment; from the viewpoint of the patient, the clinician, and the researcher.* New York: Basic Books.

DiBlas, L., Grassi, M., Liccio, R., & Momenté, S. (In Press). Assessing the interpersonal circumplex model in late childhood: The interpersonal behavior for questionnaire for children. *Assessment.*

Farsides, T., & Woodfield, R. (2003). Individual differences and undergraduate academic success: The roles of personality, intelligence, and application. *Personality and Individual Differences, 34,* 1225-1243.

Freedman, M. B., Leary, T. F., Ossorio, A. G., & Coffey, H. S. (1951). The interpersonal dimension of personality. *Journal of Personality, 20,* 143-161.

Freeman, T. M., Anderman, L. H., & Jensen, J. M. (2007). Sense of belonging in college freshman at the classroom and campus levels. *Journal of Experimental Education, 75,* 203-220.

Gerdes, H., & Mallinckrodt, B. Emotional, social, and academic adjustment of college students: A longitudinal study of retention. *Journal of Counseling and Development, 72,* 281-288.

Gifford, R. (1991). Mapping nonverbal behavior on the interpersonal circle. *Journal of Personality and Social Psychology, 61,* 279-288.

Gurtman, M. B., & Pincus, A. L. (2003). The circumplex model: Methods and research applications. In J. A. Schnika and W. F. Velicer (Eds.), *Comprehensive handbook of psychology* (pp. 407-428). Hoboken, NJ: Wiley.

Gurtman, M. B., & Pincus, A. L. (2000). Interpersonal adjective scales: Confirmation of circumplex structure from multiple perspectives. *Personality and Social Psychology Bulletin, 26,* 374-384.

Gurtman, M. B., & Balakrishnan, J. D. (1998). Circular measurement redux: The analysis and interpretation of interpersonal circle profiles. *Clinical Psychology: Science and Practice, 5,* 344-360.

Hatcher, R.L., & Rogers, D.T. (2012). The IIS-32: A brief inventory of interpersonal strengths. *Journal of Personality assessment, 94,* 683-646.

Hackett, G., & Betz, N. E. (1981). A self-efficacy approach to the career development of women. *Journal of Vocational Behavior, 18,* 326-339.

Hopwood, C. J., Ansell, E. B., Pincus, A. L., Wright, A. G. C., Lukowitsky, M. R., & Roche, M. J. (2011). The circumplex structure of interpersonal sensitivities. *Journal of Personality, 79,* 708-740.

Horowitz, L. M. (2004). Interpersonal foundations of psychopathology. Washington, DC: American Psychological Association.

Horowitz, L. M., & Wilson, K. R. (2005). Interpersonal motives and personality disorders. In S. Strack (Eds.), *Handbook of personology and psychopathology* (pp. 459- 510). Hoboken, NJ: Wiley.

Judge, T. A, & Bono, J. E. (2000). Five-factor model of personality and transformational leadership. *Journal of Applied Psychology, 85,* 751-765.

Kiesler, D. J., Schmidt, J. A., & Wagner, C. C. (1997). A circumplex inventory of impact message: An operational bridge between emotion and interpersonal behavior. In R. Plutchik and Contes (Eds.), *Circumplex models of personality and emotions* (pp. 221-244). Washington, DC: American Psychological Association.

Kiesler, D. J. (1983). The 1982 interpersonal circle: A taxonomy for complementarity in human transactions. *Psychological Review, 90,* 185-214.

Lackland, A. C. (2001). Students' choice of college majors that are gender traditional and nontraditional. *Journal of College Student Development, 42,* 39-47.

Lackland, A. C., Lisi, R. (2001). Students' choices of college majors that are gender traditional and non-traditional. *Journal of College Student Development, 42,* 39-48.

LaForge, R., Freedman, M. B., & Wiggins, J. S. (1985). Interpersonal circumplex models: 1948-1983. *Journal of Personality Assessment, 49,* 613-631.

LaForge, R. (2004). The early development of the interpersonal system of personality (ISP). *Multivariate Behavioral Research, 39,* 359-378.

Leary, T. (1957). *Interpersonal diagnosis of personality.* New York: Ronald Press.

Lent, R. W., Brown. S. D., & Larken, K. C. (1984). Relation of self-efficacy expectations to academic achievement and persistence. *Journal of Counseling Psychology, 31,* 356-362.

Lent, R. W., Brown. S. D. & Larkin, K. C. (1986). Self-efficacy in the prediction of academic performance and perceived career options. *Journal of Counseling Psychology, 33,* 256-269.

Locke, K. D., & Sadler, P. (2007). Self-efficacy, values, and complementarity in dyadic interactions: Integrating interpersonal and social-cognitive theory. *Personality and Social Psychology Bulletin, 33,* 94-109.

Locke, K. D. (2010) Circumplex measures of interpersonal constructs. In L. M. Horowitz and S. Strack (Eds.), *Handbook of interpersonal psychology* (pp. 313-324). Hoboken, NJ: Wiley

Locke, K. D. (2006). Interpersonal circumplex measures. In S. Stack (Eds.), *Differentiating normal and abnormal personality,* (2nd ed., pp. 383-400). New York, NY: Springer.

Lukowitsky, M. R., & Pincus, A. L. (2011). The pantheoretical nature of mental representations and their ability to predict interpersonal adjustment in a non-clinical sample. *Psychoanalytic Psychology, 28,* 48-74.

Martin, A.J., Dowson, M. (2009). Interpersonal relationships, motivation, engagement, and achievement: Yields for theory, current issues, and educational practice. *Review of Educational Research, 79,* 327-365.

McCreae, R. R., & Costa, P. T. (1989). The structure of interpersonal traits: Wiggins's circumplex and the five-factor model. *Journal of Personality and Social Psychology, 56,* 586-595.

Mount, M. K., Barrick, M. R., & Stewart, G. L. (1998). Five factor model of personality and performance in jobs involving interpersonal interactions. *Human Performance, 11,* 145-165.

Moskowitz, D. S. (1994). Cross situational generality and the interpersonal circumplex. *Journal of Personality and Social Psychology, 66,* 921-933.

Moskowitz, D. S. (2005). Unfolding interpersonal behavior. *Journal of Personality, 73,* 1607-1632.

Moskowitz, D. S. (2009). Coming full circle: Conceptualizing the study of interpersonal behavior. *Canadian Psychology/ Psychologie Canadienne, 50,* 33-41.

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66,* 543-578.

Picou, J. S., & Curry, E. W. (1973). Structural, interpersonal, and behavioral correlates of female adolescents' occupational choices. *Adolescence, 8,* 421-431.

Pincus, A.L., & Ansell, E.B. (2013). Interpersonal theory of personality. In J. Suls & H. Tennen (Eds.), *Handbook of Psychology Vol. 5: Personality and social psycyhology* (2nd Ed.)(pp. 141-159). Hoboken, NJ: Wiley.

Pincus, A. L. (1944). The interpersonal circumplex and the interpersonal theory: Perspectives on personality and its pathology. In S. Strack & M. Lorr (Eds.), *Differentiating normal and abnormal personality* (pp. 114-136). New York, NY: Springer.

Pincus, A. L., & Wright, A. G. C. (2010). Interpersonal diagnosis of psychopathology. In L. M. Horowitz & S. Strack (Eds.), *Handbook of interpersonal psychology* (pp. 359-381). Hoboken, NJ: Wiley.

Plutchik and Contes (Eds.), *Circumplex models of personality and emotions* (pp. 221-244). Washington, DC: American Psychological Association.

Porter, S. R., & Umbach, P.D. (2006). College major choice: An analysis of person-environment fit. *Research in Higher Education, 47,* 429-448.

Sadler, P., Ethier, N., Gunn, G. R., Duong, D., & Woody, E. (2009). Are we on the same wavelength? Interpersonal complementarity as shared cyclical patterns during interactions. *Journal of Personality and Social Psychology, 97,* 1005-1020.

Sayeed, O. B, & Jain, R. (2000). Assessing interpersonal competency of career-oriented individuals. *Journal of Organizational, 18,* 9-17.

Schunk, D. H. (1989). Self-efficacy and achievement behaviors. *Educational Psychology Review, 3,* 173-208.

Trobst, K. K. (2000). An interpersonal conceptualization and quantification of social support transactions. *Personality and Social Psychology Bulletin, 26,* 971-986.

Weiner, B. (1979). A theory of motivation for some classroom experiences. *Journal of Educational Psychology, 74,* 3-25.

Wiggins, J. S. (1982). Circumplex models of interpersonal behavior in clinical psychology. In P. C. Kendall & J. N. Butcher (Eds.), *Handbook of research methods in clinical psychology* (pp. 183-221). New York: Wiley.

Wiggins, J. S. (2003). *Paradigms of personality assessment.* New York: Guilford.

Wiggins, J. S. (1991). Agency and communion as conceptual coordinates for the understanding and measurement of interpersonal behavior. In D. Cicchetti & W. M.

Wiggins, J. S. (1979). A psychological taxonomy of trait descriptive terms: The interpersonal domain. *Journal of Personality and Social Psychology, 37,* 395-312.

Wiggins, J. S. (1996). An informal history of the interpersonal circumplex tradition. *Journal of Personality Assessment, 66,* 217-233.

Wiggins, J. S. (1997). In defense of traits. In R. Hogan, J. A. Johnson, & S. R. Briggs (Eds.), *Handbook of personality psychology* (pp. 95-141). San Diego, CA: Academic Press.

Wiggins, J. S., & Trobst, K. K. (1997). When is a circumplex an "Interpersonal Circumplex"? The case of supportive actions. In R. Plutchik and H. R Conte (Eds.), *Circumplex models of personality and emotions* (pp. 57-80). Washington, DC: American Psychological Association.

Wiggins, J. S., Trapnell, P., & Phillips, N. (1988). Psychometric and geometric characteristics of the revised interpersonal adjective scales (IAS- R). *Multivariate Behavioral Research, 23,* 517-530.

Wiggins, J. S., Phillips, N., & Trapnell, P. (1989). Circular reasoning about interpersonal behavior: Evidence concerning some untested assumptions underlying diagnostic classification. *Journal of Personality and Social Psychology, 56,* 296-305.

Worthington, A. C., & Higgs, H. (2003). Factors explaining the choice of a finance major: The role of student characteristics, personality ad perceptions of the profession. *Accounting Education, 12,* 261-281.

Wright, A. G. C, Pincus, A. L., Conroy, D. E., & Hilsenroth, M. J. (2009). Integrating methods to optimize circumplex description and comparison of groups. *Journal of Personality Assessment, 91,* 311-322.

Effects of Crop Management Practices on the Soil Health Indicators—Water Stable Aggregates and Soil Organic Matter

Samantha P. Rosado, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisors:
Dr. Heather Karsten
Associate Professor of Crop Production and Ecology
Dr. Glenna Malcolm
Research Associate and Instructor
Department of Plant Science
College of Agricultural Sciences
The Pennsylvania State University

Abstract

Soil health is integral in maintaining crop productivity, so we evaluated impacts of crop rotations on soil health using two no-till six-year rotations incorporating annual cover crops and perennials and a no-till corn/soybean rotation. This study was conducted in the Northeastern Sustainable Agriculture Research and Education (NESARE) Sustainable Dairy Cropping System at the Agricultural Research Farm at Rock Springs in State College, Pennsylvania. All crop entries are planted each year in 0.25 acre plots with four replicates that are randomized within crop rotation. We hypothesized that water stable aggregates (WSA) and soil organic matter (SOM) would be higher in crop rotations with more continuous live root cover provided by annual cover crops or perennials compared to rotations with only summer annual crops. This is because live roots help bind together soil particles and support microbial and fungal processes that increase WSA and SOM, and perennial roots contain more carbon than annuals. Ten soil cores were collected per split-plot at 0-5cm and at both 0-5cm and 5-15cm depths to measure WSA and SOM, respectively. We found that after three years, at the 0-5 cm soil depth, soil organic matter was significantly increased and water stable aggregates significantly higher in soil where corn was preceded by perennials compared to the soil of corn with prior annual cover crops or in rotation without cover crops, which were not statistically different from each other. Based on these results, recommendations can be provided to Northeastern dairy farmers on increasing their soil health by adding perennials to their rotations to ensure their productive soil's longevity.

Introduction/Literature Review

There is a limited amount of new land that can be cultivated because much of what is available cannot support agriculture (Duiker, 2011). This is due to less than ideal conditions such as the land's susceptibility to erosion, poor fertility and nutrient holding capacity, and even laws that have been put in place to protect forested lands from disappearing. Therefore, more emphasis has been placed on maintaining soil health for the long term on intensively cultivated

farmland to support increasing global food demand (Westcott and Trostle, 2012). Soil health is the capacity of a soil to function and support life. It is often evaluated as an indicator of an agroecosystem's ability to be productive over time because it influences soil water holding capacity, nutrient holding capacity and cycling, and gas exchange, which can influence long-term crop productivity and resilience to climactic stress. Two soil properties that are often measured to evaluate soil health include soil organic matter (SOM) and water stable aggregates (WSA) (Karlen et al., 1997). Organic matter is any of the dead and dying plant materials such as roots, leaves, and stems, as well as animals and other organisms that are left on the soil surface. Soil microbes can break down these materials into simpler elements and compounds that can be used by the plants. A water stable aggregate is a group of soil particles that bind together to resist disintegration by water. The portion of the aggregate that holds together when water passes over and through it is considered water stable, while particles that crumble off are considered unstable.

Soil organic matter offers many benefits to soil health, and certain management practices have been shown to increase the amount of organic matter returned to the soil. Concerning soil function, the organic acids and compounds found in soil organic matter, provide many soil benefits, such as increasing cation-exchange capacity, helping to bind soil particles into aggregates, increasing water-holding capacity, and helping to buffer pH (Brady and Weil, 1996). Higher soil organic matter levels also help support diverse subsurface activities like nutrient availability and microbial activity (Brady and Weil, 1996). Management practices such as annual tillage, short–term crop stands, and fallowing croplands are methods that adversely influence soil organic matter by reducing the production or availability of organic matter (Duiker, 2011). Conversely, soil organic matter can be maintained or possibly increased using reduced tillage or no tillage, as well as applying nutrients like manure, fertilizer, or compost, and even diverse cropping systems that incorporate perennials and legumes (Duiker, 2011; Ogunwole, 2008). Although, unlike synthetic fertilizer, manure contains soil microorganisms, which are organic materials and nutrients that drive plant and microbial metabolism and provide additional organic matter to the soil when crops and organisms die (Ogunwole, 2008). Another management practice affecting soil organic matter is the use of cover crops that replenish carbon rich organic matter through root exudates, interactions with microorganisms, and glomalin-producing mycorrhizal fungi, which are carbon-binding agents (Jastrow, Miller, and Lussenhop, 1997). These beneficial cover crops provide continuous plant cover throughout the year and put live roots into the ground, thereby enhancing soil organic matter. Other studies also support the practice of using cover crops to enhance organic matter (Duiker, 2011; Ogunwole, 2008), but fewer investigate changes over time between different crop rotations incorporating a variety of species.

Water aggregate stability directly and indirectly influences many soil processes and higher percentages of WSA can be promoted in cropping systems in several ways. Higher percentages of WSA are associated with greater carbon storage capacity, increased water infiltration ability, improved root growth, and even resistance to compaction (Brady and Weil, 1996; Grover and Karsten, 2008). Continuous tillage and leaving the soil surface bare after harvesting negatively affect the stability of these aggregates (Ogunwole, 2008). However, current research suggests that the following management practices promote aggregate stability: no till or reduced tillage management, cropping systems that keep plants in the ground for longer periods of time, leaving plant residues on soil surfaces to increase organic matter, and applications of manure amendments (Grover and Karsten, 2008; Ogunwole, 2008). Live root

systems have also been identified as a key player in promoting the formation of water stable aggregates by contributing soil organic matter, increasing microbial activity, and helping bind together soil particles, in conjunction with soil microbes, fungal hyphae, and sticky polysaccharides (Miller and Jastrow, 1998). Although there are water stable aggregates present in rotations without cover crops, they do not tend to increase over time because there are not constant live roots. A number of studies have investigated the effects of cropping systems and the presence of live roots on water stable aggregates, but few have considered the differences between individual crop roots within the system. For instance, perennials put more nutrient resources and carbohydrates into developing root systems that are equipped to store nutrients and spread deeper and farther through the soil for longer-term establishment than annuals. Additionally, perennial root systems that can be dense and thick, fine, or fibrous contribute organic matter, promote microbial activity, and are in the ground longer, all of which enhance aggregate stability (Brady and Weil, 1996). By contrast, annuals focus energy and nutrient allocations on moving from germination to seed production quickly, thus, fewer resources are allocated towards extensive development of root systems, resulting in smaller root zones that are in the ground for less of the year.

The soil health indicators, SOM and WSA, were evaluated in cropping systems under variable management practices in the Northeast Sustainable Agriculture Research and Education (NESARE) sustainable dairy cropping systems project, which was initiated in 2010 at Penn State University (PSU). The project is an interdisciplinary research effort funded by a grant awarded by the United States Department of Agriculture NESARE funds. Goals of this project include making a dairy farm sustainable by minimizing off-farm inputs, lessening environmental impacts, and remaining lucrative while increasing soil health and biodiversity. Currently, in its fifth year of crop rotation and data collection, the project utilizes a host of management practices to evaluate 1) pest management strategies, which compare a standard herbicide regiment to practices that reduce herbicides (i.e. tillage, banding herbicide, using a high residue cultivator, and adding annual companion crops) 2) manure management practices by assessing injection versus broadcasting manure, and 3) a nutrient management component looking at manure versus synthetic fertilizer applications. Such multiyear cropping system research has the potential to examine the relationship of diverse management practices and the effect that each of those decisions, both individual and combined, have on indicators of agroecosystem sustainability.

The goal of this research was to examine the effect that selected crops and their rotations had on two soil health indicators (i.e. water stable aggregates and soil organic matter), over a three-year period. Soil in corn plots were sampled in 2013, and previously in 2010, in the three different crop rotations; the corn was preceded by annual cover crops, perennial crops, or no cover crop. In examining these soil health indicators, the following hypotheses were proposed: 1) Soil of corn in crop rotations implementing continuous plant cover will have more organic matter and higher percentages of water stable aggregates in the first 0-5 cm as opposed to soil of corn in a simple rotation without continuous cover, and 2) Soil of corn that was preceded by continuous perennial root cover will have more organic matter and higher percentages of water stable aggregate in the first 0-5 cm than corn that was preceded by continuous annual root cover.

Materials and Methods

Site Description

In 2010, the NESARE Sustainable Dairy Cropping System launched on 16 acres of the PSU Agronomy Farm at the Russell E. Larson Agricultural Research Farm at Rock Springs. Typically, Centre County Pennsylvania experiences an average of 40 inches of rainfall per year. Mean climactic conditions in January reach lows of 17 F degrees with temperatures reaching the high 80s in July. Though not completely uniform, the vast majority of soil at the experimental site is a Murrill channery silt loam (Fine-loamy, mixed mesic Typic Hapludults) that slopes 0-3% with some Buchanan channery silt loam (3-8% slope) and some Hagerstown silt loam (3-8% slope).

Cropping Systems

The experiment included three crop rotations of two six-year diverse crop rotations and a two-year control rotation. Every phase of the crop rotation was planted each year for a total of 14 crop entries that were randomized within each rotation and replicated in four blocks for a total of 56 main plots (120 feet by 90 feet). Each main treatment plot was divided into split-plots (60 feet by 75 feet). Thus, two management practices were compared within each rotation in a nested split-plot design. In the pest management comparison, one split-plot was treated as standard herbicide, including a herbicide application at standard rates, spraying cover crops, two broadcast and post-emergent herbicide treatments, and a broadleaf herbicide if necessary (Figure 1). For comparison, the other split-plot was managed with a combination of other practices designed to reduce herbicide applications. The reduced herbicide practices included tillage once in six years to terminate alfalfa, spraying and rolling cover crops, banding herbicide over the crop row rather than broadcasting across the entire field with high residue cultivation twice between the crop rows, and the addition of annual small grain crops to the new seeding of alfalfa and orchard grass. In the manure management comparison, one split-plot was broadcasted with dairy manure while the other was injected with dairy manure. Finally, the nutrient management comparison differed with one split-plot treated with broadcasted manure or fertilizer and the other with injected dairy manure or fertilizer. Prior to planting any experimental rotations, in the fall of 2009 all of the fields were planted with a rye cover crop to ensure that the project treatments would not be affected by previous crop history. All of the cropping systems have been operated under no-tillage management except in the reduced herbicide grain rotation, when tillage is used to terminate alfalfa once every six years. In the case of the corn plots where soil was sampled in 2013, the tillage event had occurred in 2011.

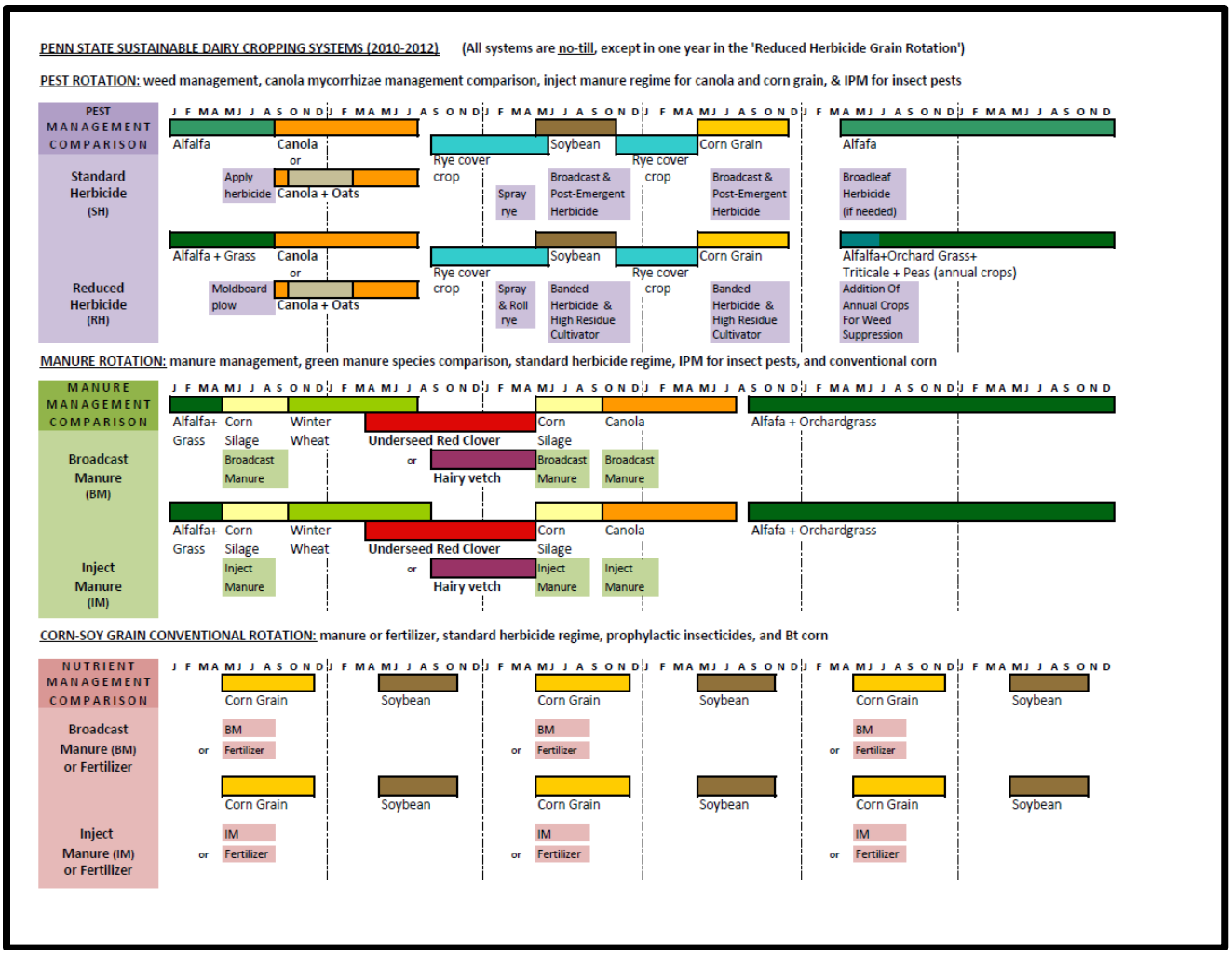


Figure 1: NESARE cropping system rotation from 2010-2012.

Aggregate Stability

Ten random composite soil samples were collected from each split-plot at a 0-15 cm depth. After collection, the samples were stored in airtight containers and moved to a cooler as soon as possible until processing. To begin processing, soil samples were sieved at field moisture and dried. Then, ten grams of soil was placed into a sieve apparatus for 1-2 mm particles and dunked into water for five minutes followed by dunking into a chemical dispersing solution (2g Na- hexametaphosphate/ 1 L DI water). Materials that passed through the sieves in the first few minutes were dried down and weighed, then labeled as the unstable aggregates. Next, a rubber-tipped probe was used for dispersing sand particles from the soil. The sand remained on the sieve while the soil fell into a collection bin. The soil was then dried down and weighed for sand corrected stable aggregate mass. Percent water stable aggregates were then calculated ([SandCorrect Ag/(SandCorrect Ag + Unstable aggregate)]*100).

Soil Organic Matter

A JMC Backsaver Soil Sampler was used to extract all soil cores for analysis. For soil organic matter, ten random soil cores were collected per main treatment at 0-5 cm and 5-15 cm depths, and composited into a single sample for each depth. After being finely ground, the soil samples were sent to the North Carolina State Soil Testing Lab where they were analyzed for elemental carbon. We used the equation developed by Ranney (1969) to convert percent carbon to percent organic matter (Percent organic matter = 0.35 + 1.80 x percent organic carbon).

Statistical Analysis

The statistical analysis software (SAS) was used to conduct an analysis of variance (ANOVA) on the data using the mixed procedure (PROC MIXED). The averaged data from an entire main plot for corn crops in each rotation were compared using Tukey's test and differences were considered significantly different at $p<0.05$ for soil organic matter and $p<0.01$ for water stable aggregates.

Results

Soil Organic Matter

In 2010, which marked the beginning of the NESARE cropping system prior to initiating treatments, there were no statistical differences in soil organic matter in either the 0-5 cm or 5-15 cm depths between the three rotations that we compared. In 2013, again the soil organic matter did not differ among the rotations at the 5-15 cm soil depth, but it did so at the 0-5 cm depth. Therefore, the remaining results and discussion will focus on soil organic matter in the 0-5 cm depth. At 0-5 cm, soil organic matter differed significantly ($p<0.05$) in the soil of corn rotations preceded by perennials compared to the soil of corn with prior annual cover crops (Figure 2). At 0-5 cm, soils of corn rotations with prior perennials had an average of 3.67% organic matter, while soil where annual cover crops were in place before corn had an average of 3.05%, which is 20% less organic matter.

At 0-5 cm, there was no significant difference between the corn in the no-cover crop rotation compared to the rotations that had prior annual cover crops or prior perennials. Soils that had no cover crops in rotation with corn measured an average of 3.18% organic matter.

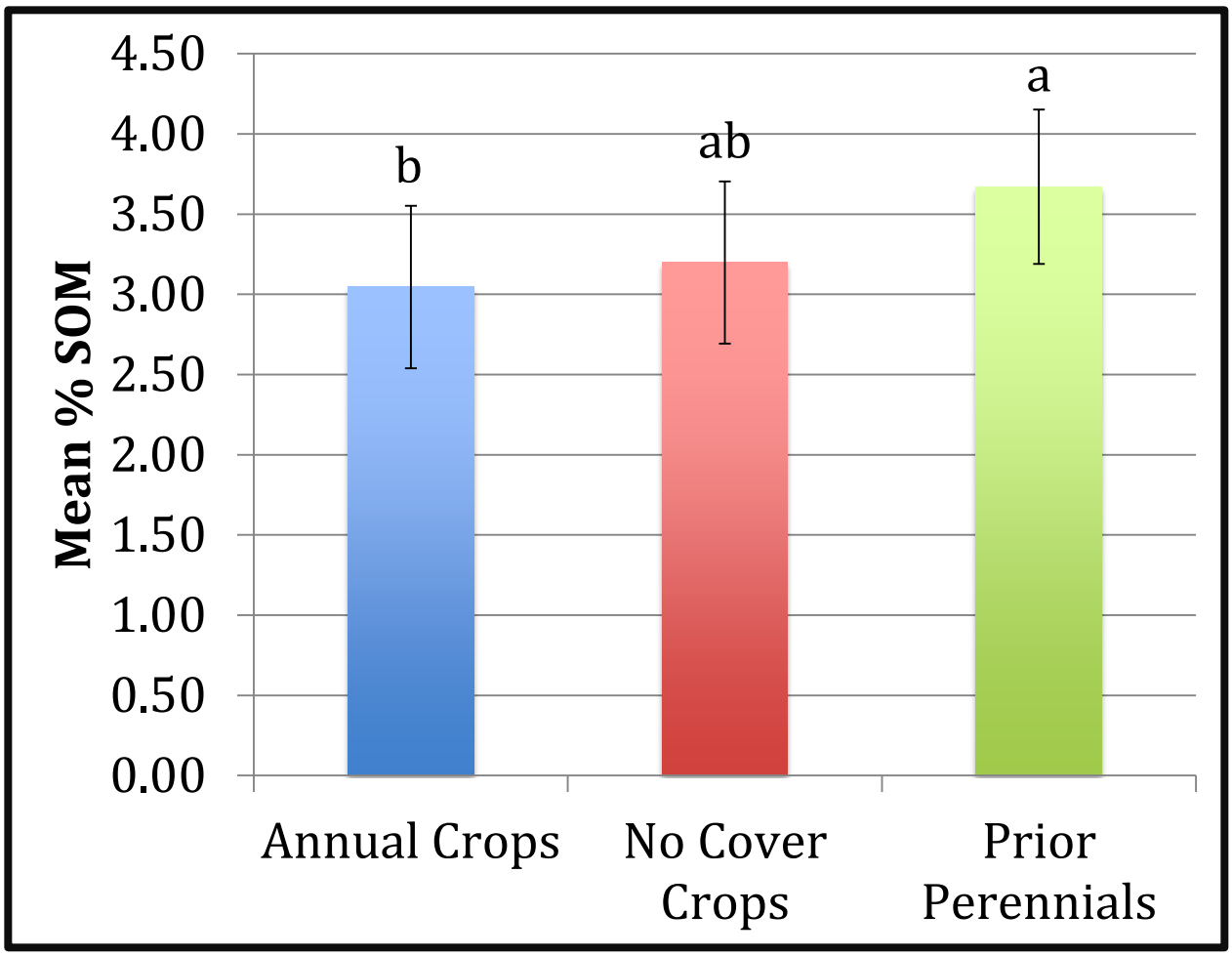


Figure 2: Mean % soil organic matter (SOM) at 0-5 cm depth in 2013. Different letters (a, b) indicate treatments that differ significantly at $p<0.05$.

For organic matter difference 2013-2010, the rotation effect between corn that was preceded by perennials compared to prior annual cover crops was significant (Figure 3). However, when no cover was compared to just previous annual cover crops, statistically, the numbers did not differ significantly. Soil in corn with prior perennials had a 70% increase in mean organic matter from 2010 to 2013, while the soil with prior annual cover crops only increased by 4%. Where there were no cover crops, soil organic matter decreased by 6%.

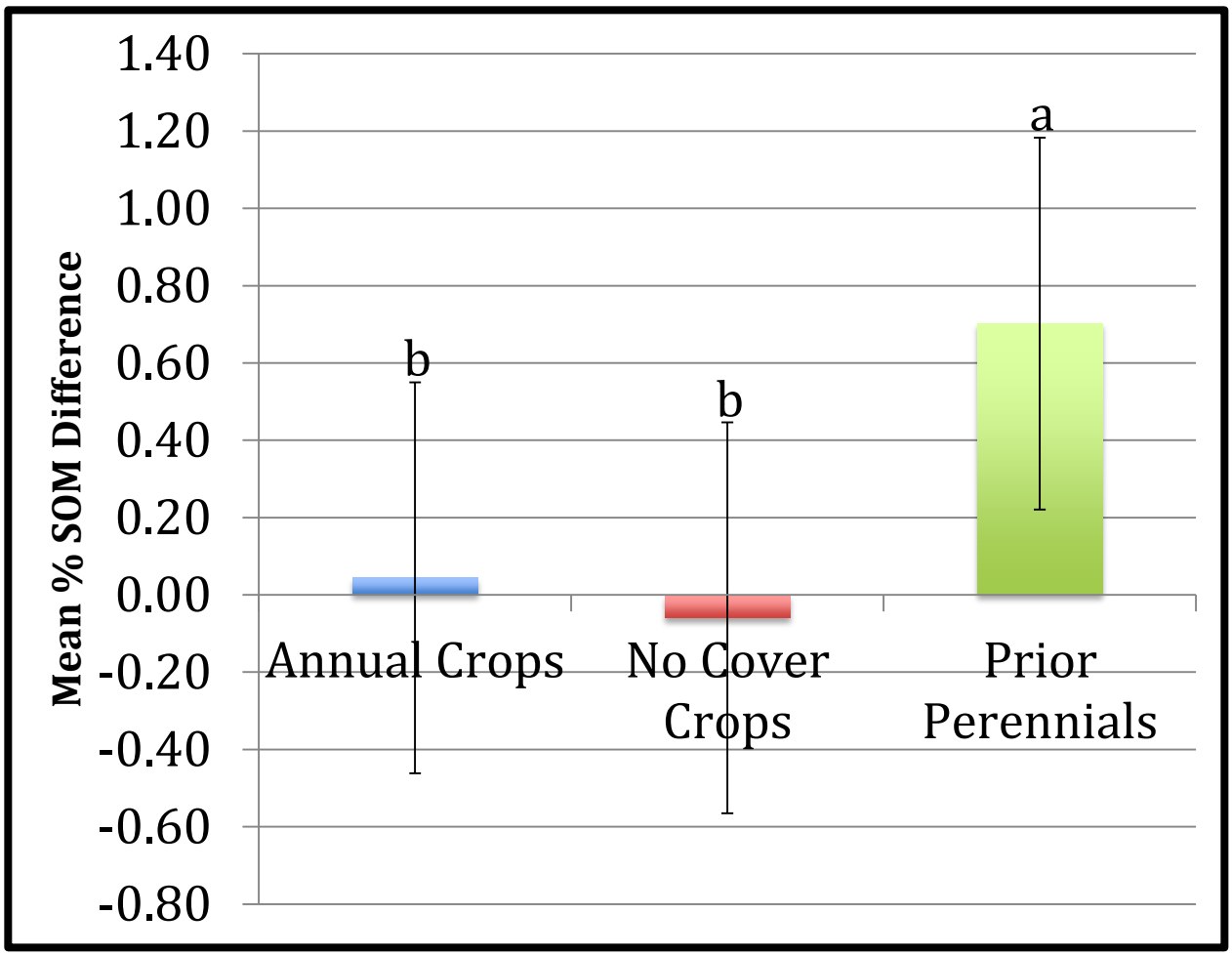


Figure 3: Mean % soil organic matter (SOM) difference from 2010 to 2013 at 0-5 cm depth. Different letters (a, b) indicate treatments that differ significantly at $p<0.05$.

Water Stable Aggregates

Again, when comparing 2010 data, there were no statistical differences in percent water stable aggregates in the rotations we compared. In 2013, water stable aggregates differed significantly ($p<0.01$) in the soil of corn rotations preceded by perennials and those with prior annual cover crops or no cover crop (Figure 4). The soils of corn in rotation with prior perennials had an average of 45.19% water stable aggregates while corn with prior annual cover crops only had an average of 38.21%, totaling an 18% difference in water stable aggregates. The soils of the no cover crop control averaged 39.18% water stable aggregates, which is 15% less water stable aggregates than the soils of corn with prior perennials. There was no statistical difference between rotations not using cover crops compared to rotations that had prior annual cover crops.

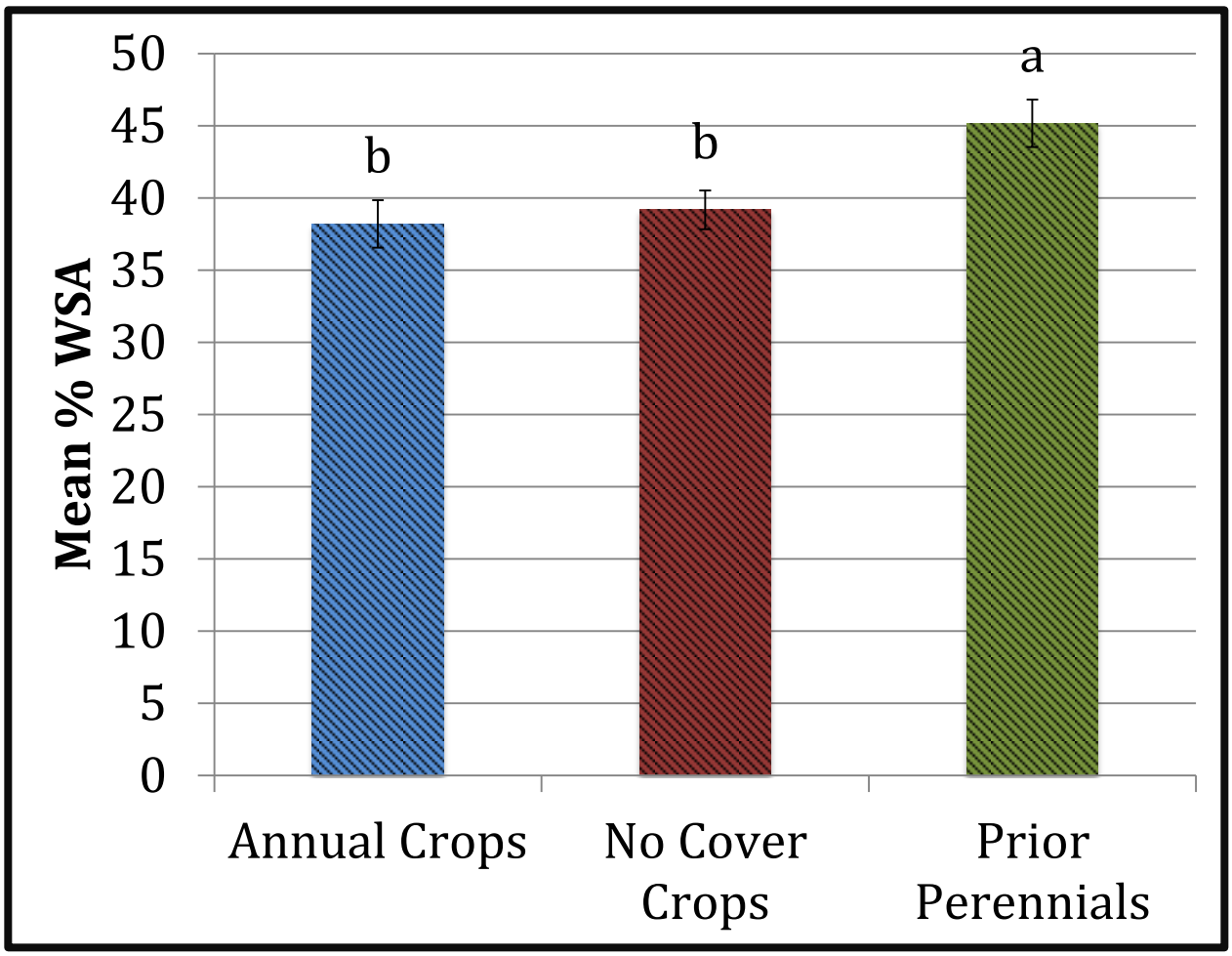


Figure 4: Mean % water stable aggregates (WSA) in 2013 at 0-15 cm depth. Different letters (a, b) indicate treatments that differ significantly at $p<0.01$.

Discussion

Soil is the foundation of crop production, and thus preserving the soil's health on existing farmland is paramount to support continually rising populations and global food demand in the long run (Westcott and Trostle, 2012). In this study, we looked at the two soil health indicators, soil organic matter and water stable aggregates. One of our primary findings is that after just three years, soil organic matter was significantly increased at the 0-5 cm soil depth (Figure 3) and water stable aggregates were significantly higher in soil where corn was in rotation with perennials compared to rotations with prior annual cover crops or in rotations without cover crops, which were not statistically different from one another (Figure 3, 4).

Soil Organic Matter

Our hypothesis stating that soil organic matter would be higher in corn rotations with continuous plant cover as opposed to corn in a simple rotation without continuous cover was not supported. We expected that the treatments in rotation with annual cover crops and perennials

would have more soil organic matter than the no cover crop control because the former two treatments had live roots in the ground for more months of the year. There was no statistical difference, however, between the no cover crop rotation, and the annual cover crop and perennial rotations (Figure 2). These results could be due to three possible confounding factors, the first being tillage. Tilling the soil incorporates organic matter lying on the soil surface by turning it under, making it more accessible to the soil microbes (Brady and Weil, 1996; Duiker, 2011). With more access, the microbes can break down the organic matter much more quickly compared to when it is being slowly decomposed on the soil surface. In 2011, in the reduced herbicide treatment in the pest rotation (Figure 1), which is the corn in rotation with annual cover crops, there was a tillage event to kill a perennial alfalfa stand instead of spraying herbicide before winter canola was planted (Figure 1). This tillage event could explain why we saw lower percentages of organic matter in soils where corn was preceded by annual cover crops, but does not explain why we saw the same levels of SOM in our perennials preceding corn treatment, where no tillage occurred.

The second confounding factor that could explain the lack of difference between all three treatments is the method of soil sampling used. As part of the NESARE experiment, there was a comparison between broadcast and injected manure in the rotation that included perennials or no cover crop and once in the rotation with annual cover crops (Figure 1). Soil samples were collected randomly from both of those treatments. However, there is some evidence to suggest that random soil sampling does not provide an adequate representation of nutrients in the manure injected sites (R. Meinen, personal communication). The manure injector injects manure in bands that are spaced 30 inches apart in the soil. Thus, when random sampling was used, there is a chance that none of the samples were on or around that injection site and the soil data would show less organic matter than was present across the field. There is also a smaller chance that one could have sampled right on the band, causing an overestimation in the average organic matter in the soil. These bands of concentrated manure organic matter likely increased the variability of the soil organic matter data.

Finally, a third factor that could explain why soil organic matter was statistically equivalent in soil where corn was in rotation with annual cover crops and in soil in the no cover crop control was organic matter rich corn stover (Brady and Weil, 1996). Even though there were long fallow periods with no live roots present contributing organic matter between crop entries in the no cover crop control, there was a significant amount of corn stover left on the soil surface. In a no-till system, soil organic matter is not plowed under, and thus accumulates in the top 0-5 cm of the soil, breaking down very slowly. The other rotations did not include corn grain that left corn stover on the soil, and the rotation with annual cover crops prior to corn used canola, soybean, and rye cover crop as the annuals, which did not leave behind a lot of residue for the soil microbes to break down. Further, the rye cover crop was planted late in the fall (late October-early November) and was not present for very long to produce many roots and above-ground biomass. It is possible that this additional organic matter breaking down slowly on the soil surface in the no cover crop control resulted in there being no significant differences at the 0-5 cm depth between the treatments.

Our hypothesis that corn preceded by continuous perennial root cover in comparison to corn that was preceded by continuous annual root cover would have more organic matter was supported. Soil organic matter at 0-5 cm depth was 20% higher in rotations with a history of perennials than those using annual cover crops. This supports the idea that perennials contribute

more organic matter to the soil than annuals because they have a larger root mass that is present for a longer period of time than annual roots.

Water Stable Aggregates

Our hypothesis stating that water stable aggregates (WSA) would be higher in corn rotations with continuous plant cover as opposed to corn in a simple rotation without continuous cover was only partially supported. Corn in rotation with perennials had soil with 15% higher WSA than corn in rotation without a cover crop (Figure 4). Conversely, WSA of soil in corn in rotation with annual cover crops was not statistically different from corn that was in rotation without any cover crops (Figure 4). There are a few possible confounding factors that could explain why this occurred. First, even though the rotations were primarily no-till, which promotes the formation of aggregates, there was one tillage event in 2011 that occurred in the corn rotation with prior annual cover crops (Figure 1), which breaks up aggregates (Brady and Weil, 1996; Duiker 2011). This could explain why water stable aggregates were the same in the rotation with annual cover crops compared to the rotation without a cover crop. Between soil sampling in 2011 and 2013, adequate time may not have passed for plant roots and soil organisms to rebuild water stable aggregates and recover from the effects of the tillage event.

Another possible explanation for the lack of difference could be the fungi living in symbiosis with the crop roots. Corn roots host mycorrhizal fungi, which can help bind together soil aggregates (Miller and Jastrow, 1998). In the corn rotation with prior annual cover crops though, canola, rye, and soybean were present. Canola is not a host of mycorrhizal fungi, and rye may not have as much of a vibrant and extensive fungal community as corn does. In addition, the injected manure bands likely promote more soil microorganisms and binding of soil aggregates. However, the limits of the random sampling method described above may not have allowed us to accurately sample the manure band zones adding another possible confounding factor.

As we expected, soil in corn in rotations implementing prior perennials compared to those using annual cover crops had 18% higher water stable aggregates. This supports our rationale that perennials, which allocate more carbohydrates into the development of their dense and complex root systems that are also present for a longer period of time than in annuals, contribute to building more water stable aggregates than annual cover crops (Chatigny et al., 1997).

Conclusions

In this experiment, having more complex and developed live root systems in the ground for a longer period of time had a more pronounced effect on both soil organic matter in the top 0-5 cm and water stable aggregates in some cases, than smaller live roots that were not present in the ground for as long. Perennials before corn increased organic matter at 0-5 cm depth and water stable aggregates more than annual cover crops before corn. However, there was no difference in soil organic matter between no cover crop and the other two treatments (prior annual cover crops or perennials) and no difference in water stable aggregates in corn preceded by annual cover crops and corn with no cover crop. These results that we did not predict suggest that additional factors may have an effect on increasing soil organic matter and water stable aggregates, such as tillage, random sampling in fields that were injected with manure, and corn

stover left on the surface of our no cover crop control. Thus, the only assumptions we can draw from the results are that perennials before cash crops have the potential to increase the two soil health indicators analyzed here, organic matter and water stable aggregates.

From here, recommendations can be provided to Northeastern dairy farmers on increasing their soil health by implementing perennials into their rotations in order to secure their productive soil's longevity. There may be limitations however that could cause farmers to not start perennials in their rotations, such as tying up land that could otherwise be used to grow cash crops or even just not having equipment, the market, or animals for forage, silage, and hay making. Further research may assess 1) if the increases in organic matter and water stable aggregates will continue to rise or change over time, 2) if sampling treatments with injected manure with a more spatially representative method will reveal treatment differences, 3) if the impact on soil organic matter and water stable aggregates can be isolated and quantified, and 4) if these soil health indicators significantly differ in one of our diverse rotations when comparing perennial legumes with taproots and perennial grasses with fibrous roots.

Literature Cited

Brady, N. C., & Weil, R. R. (1996). *The nature and properties of soils*. Upper Saddle River, N.J: Prentice Hall.

Chantigny, M., Angers, D., Prevost, D., Vezina, L., & Chalifour, F. (1997). Soil aggregation and fungal and bacterial biomass under annual and perennial cropping systems. *Soil Science Society of America Journal, 61*(1), 262-267. doi:10.2136/sssaj1997.03615995006100010037x

Duiker, S. W. (2011). Effect of Land Use and Soil Management on Soil Properties and Processes. In M.K. Shukla (Ed.), *Soil Hydrology, Land Use, and Agriculture: Measurement and Modelling*. (pp. 291-311). Cambridge, MA: Cabi.

Grover, K. K., & Karsten, H. D. (2008). *Long-term cropping systems effects on soil aggregate stability, corn grain yields, and yield stability.* ProQuest, UMI Dissertations Publishing.

Jastrow, J., Miller, R., & Lussenhop, J. (1998). Contributions of interacting biological mechanisms to soil aggregate stabilization in restored prairie. *Soil Biology & Biochemistry, 30*(7), 905-916. doi:10.1016/S0038-0717(97)00207-1

Karlen, D., Mausbach, M., Doran, J., Cline, R., Harris, R., & Schuman, G. (1997). Soil quality: A concept, definition, and framework for evaluation. *Soil Science Society of America Journal, 61*(1), 4-10. doi:10.2136/sssaj1997.03615995006100010001x

Miller, R. M., & Jastrow, J. D. (1990). Hierarchy of root and mycorrhizal fungal interactions with soil aggregation. *Soil Biology and Biochemistry, 22*(5), 579-584. doi:10.1016/0038-0717(90)90001-G

Ogunwole, J. (2008). Soil aggregate characteristics and organic carbon concentration after 45 annual applications of manure and inorganic fertilizer. *Biological Agriculture & Horticulture, 25*(3), 223-233.

Ranney, R. W. (1969). An organic carbon-organic matter conversion equation for Pennsylvania surface soils. *Soil Science Society of America Journal, 33*(5), 809-811.

Westcott, P., Trostle, R. (2012, September 20). *Long-Term Prospects for Agriculture Reflect Growing Demand for Food, Fiber, and Fuel*. Retrieved July 15, 2014 from http://www.ers.usda.gov/amber-waves/2012-september/long-term-prospects-for-agriculture.aspx#.U8bPnahyk7B.

Modeling Photoacoustic Tomography using k-Wave

Jonathan C. Russell, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Richard L. Tutwiler, Ph.D
Senior Scientist, Professor of Acoustics
Deputy Director, Center for Network-Centric Cognition and Information Sciences
Department Head, Imaging Systems and Processing
Applied Research Laboratory
The Pennsylvania State University

Abstract

Photoacoustic tomography (PAT) is a hybrid imaging technique that offers similar medical potential as ultrasound and optical imaging. Although efforts to innovate Photoacoustic scanners have been scarce, newer developments such as k-Wave will enable their optimal imaging capability. Despite k-Wave's ability to simulate PAT, few researchers utilize this technology. Thus, this project explored the effects of altering the properties of Photoacoustic scanners on the reconstruction through the use of k-Wave. With the capability to optimize photoacoustic sensors through simulations, PAT in general will become more effective.

Introduction

The photoacoustic effect, which is what photoacoustic tomography is based on, is the generation of acoustic waves from an object absorbing light. The effect was discovered by Alexander Graham Bell in 1880, but very little substantial progress has been made until recently. Photoacoustic tomography (PAT) is an up and coming imaging technology utilizing the photoacoustic effect. PAT has been used for more effectively administering medical treatments[2], visualizing signs of tumors in tissue[3], studying epilepsy's effects on the brain[4], and viewing the effects of heart attacks[5]. These various uses have increased PAT research in diverse science fields such as imaging, chemistry, physics, and biomedicine. For the past decade, researchers have been focusing on making PAT more optimal. For example, the process of Multispectral Optoacoustic Tomography (MSOT) has been used to tune PAT specifically for certain tissue by utilizing its absorption properties and exciting the tissue to give a more pronounced image[6]. Given that PAT research is relatively new, researchers continue to seek more and more improvements for PAT by finding more and more applications for it, and optimizing the process for certain cases. This study considers k-Wave because this MATLAB toolbox simulates reconstructions of photoacoustic wave fields. Although several researchers investigate the development of k-Wave, few studies utilize k-wave to optimize PAT.

Photoacoustic Theory

The initial step in photoacoustic tomography is the laser excitation. The laser frequency is related to the absorption/thermal expansion of the source as well. To generate high frequency (short wavelength) sound waves from the source, which will allow for higher resolutions, the laser pulse must be shorter than both the thermal relaxation time $\tau_{(th)}$ and the stress relaxation

time $\tau_{(s)}$ respectively defined by the below equations[7]. (The speed of sound in tissue (vs) is typically about 1500m/s due to the density of the media in the body)[8].

$$\tau_{th} = \frac{d_c^2}{\alpha_{th}} \quad (1) \qquad \tau_s = \frac{d_c}{v_s} \quad (2)$$

In these equations d_c is the characteristic dimension of the source, α is the thermal diffusivity, and v_s is the speed of sound in the medium. Since blood is the major absorber in biological tissue (specifically the hemoglobin in the blood), the majority of signals occurs where there is a high concentration of blood[9].

With scattering being orders of magnitude smaller for sound waves as opposed to light propagating through the body, the major concern is with attenuation in certain media, which can modeled by this equation.

$$\alpha = af^b[dB/cm] \quad (3)$$

In equation (3), a is a constant dependent on the tissue, and b is generally assumed to be 1, which will typically work. This attenuation a is more present in higher frequencies f, thus resolution will be decreased. If the penetration depth (cm) is reduced, the resolution can be increased as there will be less attenuation present. This trade-off leads to multispectral systems, since low frequencies are better for depth and signal to noise ratio, and higher frequencies have better resolution.

k-Wave

k-Wave[10] is a toolbox that simulates acoustic wave propagation. Recently, work has been done to extend this use specifically for both ultrasound imaging and photoacoustic tomography. As indicated in the Approach to Improvement section, it utilizes specific parameters, such as the medium's sound speed, the source's properties, and many more, to propagate the waves. Time reversal and Fast Fourier Transforms (FFT) are the methods which enable k-Wave to calculate the partial differential equations related to the reconstruction. The most commonly used numerical methods for solving partial differential equations in acoustics are the finite-difference, finite-element, and boundary-element methods. Although appropriate for many applications, for time domain modeling of broadband or high-frequency waves, they can become cumbersome and slow. This is due to the requirements for many grid points per wavelength and small time-steps to minimize unwanted numerical dispersion. The finite difference scheme is used in k-Wave because it is the only scheme that can calculate rates of change in the time domain. Pseudo-spectral methods (an extension of finite difference methods) improve the efficiency, but lose the capability to calculate rates of change in the time domain. In a homogenous medium, the pseudo-spectral method can be effectively utilized without the loss of information.

Since a finite sized computational grid is being used for these wave fields, a special scheme will be needed for calculations near the boundaries. To account for that, a perfectly matched layer (PML) is implemented on the boundaries of the computational grid. The PML is an added area

to the outer borders of the computational grid that absorbs remaining amplitudes as they propagate to the boundaries so unnecessary reflections do not occur. With the PML included, the first order acoustic equations become[11]:

$$\frac{\partial \mathbf{u}}{\partial t} = -\frac{1}{\rho_0}\nabla p - \boldsymbol{\alpha}\cdot\mathbf{u} \quad (4)$$

$$\frac{\partial \rho_x}{\partial t} = -\rho_0\frac{\partial u_x}{\partial x} - \alpha_x\rho_x \quad (5)$$

$$p = c_0^2\sum \rho_{x,y,z} \quad (6)$$

Equation (5) is used for directions [x, y, and z] as well (if 3 dimensional). [Alpha] is the anisotropic absorption in nepers/meter which is only nonzero in the PML. [p] is the acoustic density, [u] is the acoustic particle velocity, and [c] is the thermodynamic sound speed.

Two types of reconstruction are used in k-Wave, time reversal image reconstruction, and one-step reconstruction using Fast Fourier Transforms. In time reversal, the data recorded by the sensors is put in reverse order and distributed over a surface as similar to the conditions in which the data was captured, but in the reversal, the original source is removed leaving an empty grid. The reconstruction is stopped at a certain time at which point the original source should be recreated. Time reversal is derived for homogenous media, but with the application of Green's theorem it can be further applied to heterogeneous media[12].

Approach to Improvement

Instead of finding specific optimal conditions, trends of improvement will be observed. A reason for this is because every scenario in which PAT is used is different and will most likely have different optimal settings, but if trends of improvement through altering the parameters can be found, then these observations can be used across many applications. k-Wave allows for a very thorough customization of many of the system's parameters. Alterations to these parameters will be analyzed to obtain the most beneficial design for certain scenarios. Some parameters will be the number of sensors in the array, initial propagation magnitude, reconstruction algorithm, single emission vs pulse rates, and others as will be discussed in the conclusion. Due to the nature of this analysis, only graphical comparisons will be used. Since trends are what are being analyzed, graphical depictions should allow for more than enough detail.

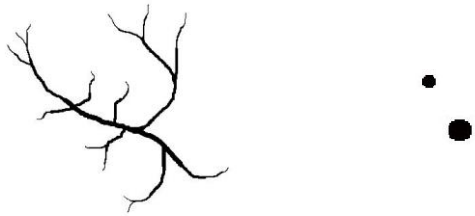


Figure 1, 2: The study will look at the effects of changing the parameters for two discs as well as a more complex shape as would be seen in the vascular system. Here are bitmap images of the sample sources used in the reconstructions.

Findings

This section will present the effects that changing each of the parameters had and briefly compare the parameters against each other.

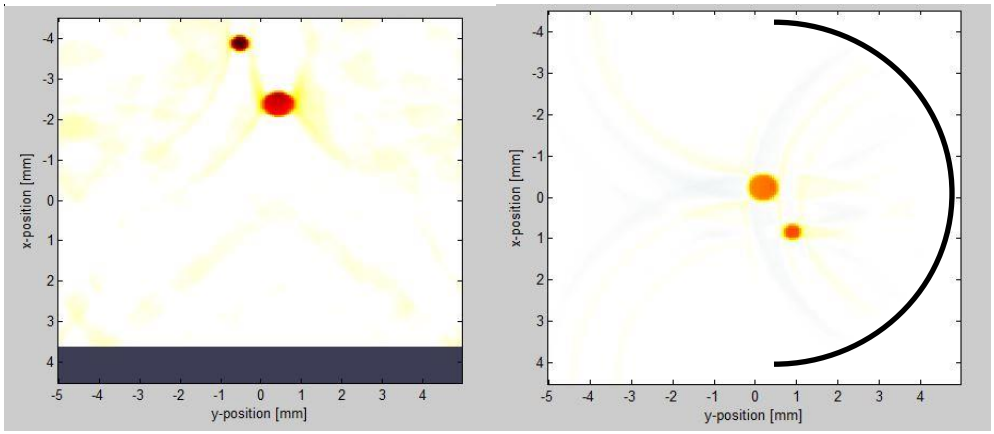


Figure 3, 4: (Left) FFT reconstruction of the disc image. The sensors are a linear array on the upper border of the graph. (Right) Reconstruction using time reversal with the same source, just positioned toward the focal point of the array. Both images use a magnitude of 1 pascal and 225 sensors.

As can be seen in figure 3 using the time reversal reconstruction algorithm, there are interference artifacts, but the overall image reconstruction is good. Also the disc nearer to the sensors has very solid edges; meanwhile the other disc's edges lose some resolution and there are more artifacts in the immediate area. In figure 4, regardless of the disc being at the focal point, it retained good shape.

The time-reversal reconstruction method uses the length of the time array and reverses the temporal array to capture what the initial pressure source would look like. The information being sent out from each sensor collides with one, which explains the added artifacts, but produces a very accurate reconstruction.

As mentioned earlier, the variables to be tested are the number of sensors in the array, the number of pulses, the reconstruction algorithm, and how the source characteristics affect the reconstructed image.

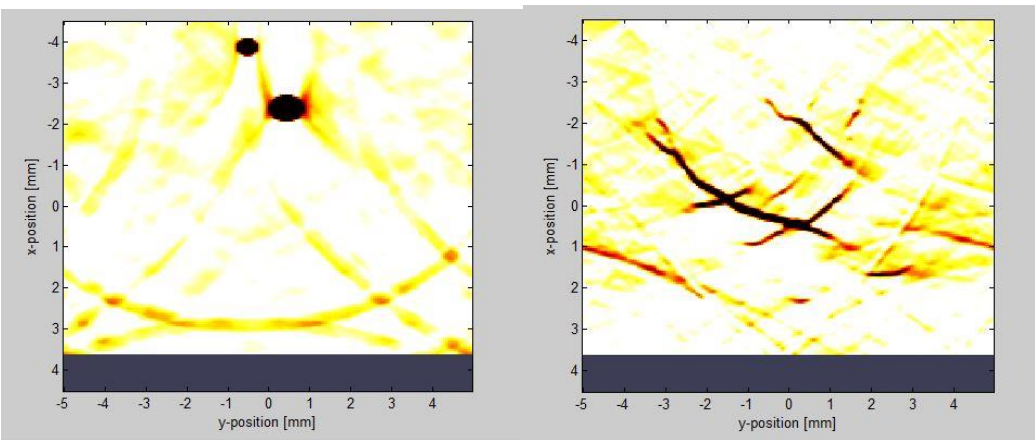


Figure 5, 6: Reconstruction using a magnitude of 3 pulses, 175 sensors, 8 pulses, and FFTs. As can be seen, the FFT reconstruction method could not image well with multiple pulses and could not image the vascular image at all due to its distance from the array.

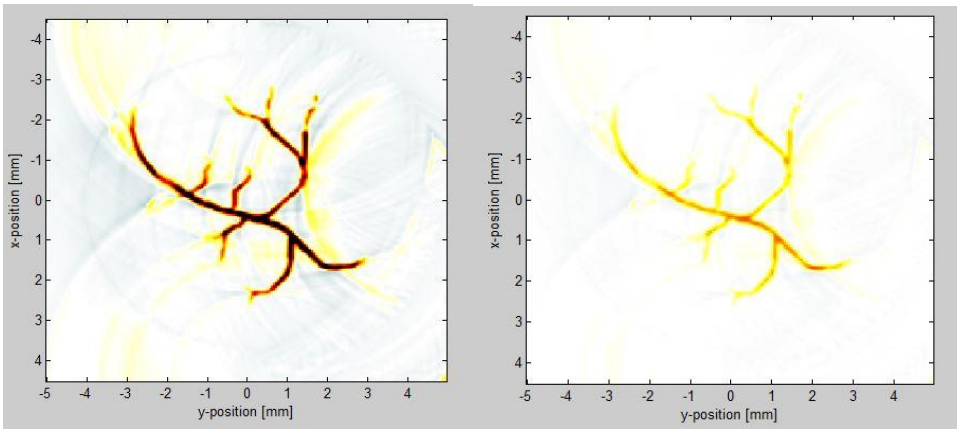


Figure 7, 8: Contrasting these two figures shows how the initial magnitude affects the reconstruction. On the left was a magnitude of 3 pascals, and it was only 1 pascal on the right, which was the only difference. While the edges were not as well defined, many of the artifacts were reduced, so pending on the application, a much lower initial magnitude may be desired.

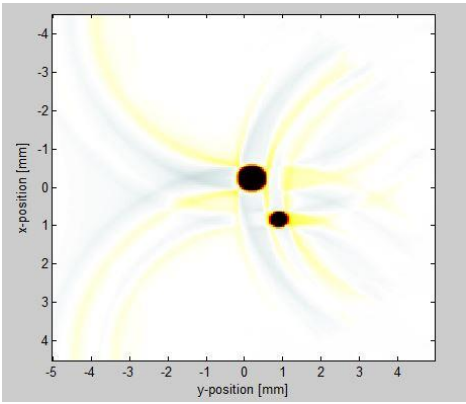


Figure 9: In comparison to figure 4, this figure has much more defined artifacts, where in figure 4 the disc was still well defined. If there is a simple image in the focal point (or near) of the array, then a lower initial magnitude will create a better image.

If the other variables are held constant, it can be observed that there is a point of diminishing returns in the number of sensors once 175 sensors are used for image reconstruction and 125 sensors for FFT reconstruction.

While it was shown that FFT reconstruction did not have many uses for the tested variables, it must be mentioned that it performs much quicker than time reversal. The near field image reconstruction is good enough that it has potential use as a real-time scanner for small depths.

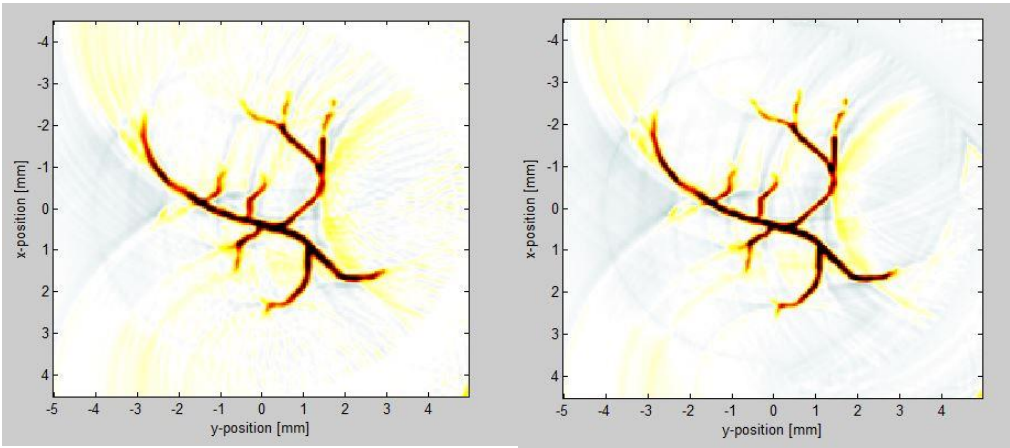


Figure 10, 11: The image on the left uses 8 pulses, while the image on the left uses only 1. It can be seen that adding the extra pulses did not necessarily affect the source, but it helped in reducing the artifacts around the source.

To determine the effectiveness of the pulses, each pulse was stored in the sensors, then the average of each pulse's reconstruction is taken to get a more consistent result. The effect of the pulses is minimal, but where it does improve the reconstruction is in the precise areas such as the vertices of the vascular image.

Discussion

This paper showcases the modeling properties of k-Wave for photoacoustic tomography. Using a standard design for a photoacoustic scanner, modifications were made to investigate any improvements that could be made. k-Wave showed good diversity in being able to accurately model current imaging capabilities and had enough diversity to add useful altercations. For more detailed images and for images at greater depth, the results show that the time-reversal image reconstruction method was superior. The only real benefits of FFT image reconstruction was the speed at which it could be done.

Due to time constraints, not all the capabilities of k-Wave were utilized. Future work could introduce using transducers as sensors as opposed to infinitely small points. This would add an entire dimension of designing the transducer properties and how the reconstruction would be affected. Image reconstruction in three dimensions also needs to be explored and is well within the capabilities of k-Wave. k-Wave has shown promising features to help the thriving development of Photoacoustic Tomography.

Acknowledgements
I would like to thank Dr. Richard Tutwiler, Dr. Sean Knecht, and Dr. Eli Byrne of The Pennsylvania State University for the opportunity to work on this project and for all of their support. I would also like to thank the Ronald E. McNair Program at The Pennsylvania State University for helping me to prepare for my time this summer and make the best of it. Finally, I'd like to thank my friend Mr. Edward Lu, a member of the Support and Development team at IBM, for technical assistance in the programming.

References

[1] Bell, Alexander G "On the production of sound by light" *Am. J. Sci.* 20 (1880): 305.

[2] De La Zerda, Adam, et al. "Carbon nanotubes as photoacoustic molecular imaging agents in living mice." *Nature nanotechnology* 3.9 (2008): 557-562.

[3] Ku, Geng, et al. "Imaging of tumor angiogenesis in rat brains in vivo by photoacoustic tomography." *Applied optics* 44.5 (2005): 770-775.

[4] Zhang, Qizhi, et al. "Non-invasive imaging of epileptic seizures in vivo using photoacoustic tomography." *Physics in medicine and biology* 53.7 (2008): 1921.

[5] Taruttis, Adrian, et al. "Multispectral optoacoustic tomography of myocardial infarction." *Photoacoustics* 1.1 (2013): 3-8.

[6] Ma, Rui, et al. "Multispectral optoacoustic tomography (MSOT) scanner for whole-body small animal imaging." *Optics express* 17.24 (2009): 21414-21426.

[7] De Montigny, Etienne. "Photoacoustic Tomography: Principles and applications." (2011).

[8] Nasoni, Richard L. "Temperature corrected speed of sound for use in soft tissue imaging." *Medical physics* 8.4 (1981): 513-515.

[9] Li, Changhui, and Lihong V. Wang. "Photoacoustic tomography and sensing in biomedicine." *Physics in medicine and biology* 54.19 (2009): R59.

[10] Treeby, Bradley E., and Benjamin T. Cox. "k-Wave: MATLAB toolbox for the simulation and reconstruction of photoacoustic wave fields." *Journal of biomedical optics* 15.2 (2010): 021314-021314.

[11] Treeby, Bradley E., Edward Z. Zhang, and B. T. Cox. "Photoacoustic tomography in absorbing acoustic media using time reversal." *Inverse Problems* 26.11 (2010): 115003.

[12] Xu, Yuan, and Lihong V. Wang. "Time reversal and its application to tomography with diffracting sources." *Physical review letters* 92.3 (2004): 033902.

Heuristic Repression: Why Modern Latin American Dictatorships Target Underrepresented Racial Groups

Shidhara Torres, McNair Scholar
The Pennsylvania State University

McNair Faculty Research Advisor:
Joseph G. Wright, Ph.D
Associate Professor of Political Science
Department of Political Science
College of Liberal Arts
The Pennsylvania State University

Abstract

Why do security forces in Latin America disproportionately target racial minorities? This article argues that the regime leadership's racial makeup determines whether they racially target civilians. Using previously formulated databases regarding ethnic inequality and power as well as cases of violence perpetrated by security forces, this study supports the hypothesis that Latin American regimes are more likely to ethnically target civilians of certain races if the leadership is racially homogenous. On the other hand, other indicators outside of race, such as socioeconomic standing are used to target civilians if the security leadership is heterogeneous.

Introduction

There is limited literature in the topic of racial targeting and Latin American security forces, and the literature that is available does not focus on the racial attributes of the leadership itself as a way of identifying whom they will target. Latin American governments have a history of both racial discrimination (*Horwedel, 2005*) and violent repression *(Duff, McCamant, & Morales, 1976).* This article attempts to provide evidence that repression disproportionately affects racial minorities in two Latin American countries and that this can be foreshadowed by the racial makeup of the state's security leadership. In this context, security leadership is used to define the higher ranking officials of the state's armed forces. These are the individuals who have the power to make choices regarding who the military represses. By comparing whom and how the security forces target in two autocratic regimes that have distinct ethnic compositions of their security force leadership, we can examine whether race contributes to state-sponsored violence. This paper also attempts to theorize about why heterogeneous and/or homogeneous militaries target civilians who are underrepresented by looking into each of the two countries' racial history and the composition of the opposition group and the threat they may pose. This study argues that countries with more homogenous security forces are more likely to take a civilian's race as a cue that he/she is a member of the opposition, and thus target him for repression.

Background

Race in Latin America

By "underrepresented," this literature does not mean "minorities" in a quantitative sense, as a state's racial minority can be well-represented and wield the majority of power in a nation. Instead, the term encompasses those who are prevented from gaining access to rights or who lack representation in the state's government compared to their percentage of the population, even if they are the majority of the population percentage wise, which is what most states consider "minorities" *(*Nagengast, 1994).

Since colonization, the perceived inferiority of non-European groups was apparent, though the groups were not all at the same level of inferiority. According to Wade (1997), the indigenous people of Latin America were perceived as a group to be enslaved, but also protected. This was due to the fact that Europeans had not come into contact with indigenous peoples before. This group was not only unheard of, but openly practiced non-Christian religions that the Europeans deemed backwards and uncivilized. Because Europeans had held contact with Africans and introduced Christianity earlier on, this "protection" was not extended to African slaves. In order to create a difference in these two slave categories, along with the mixed peoples, such as mestizos (Indigenous and European) and zambos (Afro-descendant and Indigenous) that resulted, a hierarchical system, or sociedad de castas, was put in place. Europeans were at the top of this structure, while indigenous and afro-descendants were at the bottom, with the middle being reserved for the various mixtures, family lines, and career occupations.

Repression in Latin America

This study defines "repression" as the state-sponsored use or threat of direct or indirect violence. This violence is perpetrated or allowed to happen by the regime in order to reach a social, political, or economic goal (*Nagengast, 1994*).

Times of conflict and instability tend to produce governments that partake in repressive acts against civilians they deem as a threat. Latin America governments have practiced repression in numerous occasions, including authoritarian regimes in Peru, Argentina, Brazil, Nicaragua, Guatemala, El Salvador, Mexico, Dominican Republic, Venezuela, Cuba, and Chile. These instances began with "collective acts" carried out by those who oppose the government or actions it has taken. One of the state's responses to this is repression (*Franklin, 2009*).

Theories

Although it is necessary to be aware of the possibility that certain types of leaderships are more likely to repress underrepresented groups, it is important to attempt to determine the reason for which the regime represses in the first place. Reasons for repression of certain groups throughout Latin America may be because those in power are faced with the security dilemma or a threat to their economic stakeholding, or because they possess an idea of racial superiority. Both have an origin in the history of Latin America, which hosted the oppression and the discrimination of non-European minority groups since colonization.

The loss of power can be a problem to security leaders for two reasons. One, they risk losing economic power, and, two, they face the possibility of the loss of their lives. As most dictators attempt to hold power in the state's major industries, the loss of power can also mean

the loss of the stake they hold in the industries. This monopoly on the state's economy by members of a country's leadership has occurred via reforms giving ownership of industries to the government (*Tullock, 1986*). Proof of this can be found in vehicle-allocations provided by officials in exchange for support in the U.S.S.R. (*Lazarev & Gregory, 2003*). In a state in which this theory is the reason for the repression of underrepresented groups, the leaders of security forces should be found to hold large shares in industries and would stand to lose them if they lose power.

The security dilemma

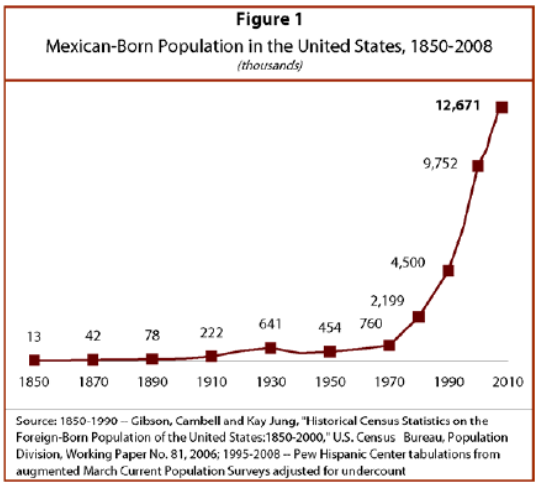
A graver outcome of the loss of power is the endangerment of the leaders' lives. One explanation for why an autocratic regime would target civilians of a particular group would be the overall safety of the leaders in power at the time. In trying to secure their state, the government can face negative outcomes (*Posen, 1993*). By using force against civilians, military officials have to be afraid that if those who have been victims of this violence were to come to power, they would seek to reciprocate the abuse. Thus, governments that have used state-sponsored violence targeted to a particular group fear losing power and losing their lives at the hand of their victims and must continue to repress them in order to avoid reciprocation. Race can then instead be seen as an indicator of who is in the opposition group, and used for strategically attacking those who are seen to be most likely to pose a threat (*Mele & Siegel, 2014*). In order for this theory to be applicable to a state's autocratic regime, the opposition has to have enough power and resentment to pose a threat.

Racial superiority

The second reason would be the idea that certain races or ethnicities are more suitable to be in positions of power than others. The racial and occupational caste system structure that has been in place since colonization in Latin America mostly remains in modern times, although now in an informal social sense. Steps have been taken to integrate the underrepresented groups into society through legislation promoting inclusion. According to information from the Minorities at Risk (2009) project, the Chavez government in Venezuela has attempted to work with the indigenous in Venezuela by demarcating indigenous territory, an issue that has caused continuous land disputes. These kinds of legislation, however, have been vulnerable due to a lack of resources and internal power struggles, leading to the support and integration of minority groups within Latin America being a slow process (Wade, 1997). A society with an internalized belief about the unsuitability of certain races for power could make it difficult for underrepresented groups to gain adequate representation in the government. In order for this theory to be the reason that a state represses an underrepresented group, the previous two theories must not be in place. The sole reason for repression of these groups must be a history of discrimination that has remained in place.

Relevance

During times of armed conflict, citizens tend to flee their home states. This loss of work force leads to less able bodies to aid in the nation's development and the increasing of its GDP. According to research done by the PEW Research Center, during the 1990s, there was a sharp increase in migration from Mexico into the United States.



Source: www.pewhispanic.org

During this time, the North American Free Trade Agreement was signed. However, the southern region of Mexico was also experiencing armed conflicts. The conclusion that the spike in migration from Mexico occurred due to not only NAFTA, but the armed conflict as well, can be drawn from this occurrence.

Methodology

In order to compare the racial makeup of the leadership and whether that has an effect on racial targeting, this study focuses on two countries' autocratic regimes, one with a racially homogeneous leadership (Mexico during the beginning of the Chiapas conflict) and another with a racially heterogeneous leadership (Venezuela during the Maduro presidency). In this study, the racial composition of the leadership in each of the regimes will be the independent variable. The dependent variable will then be the ethnic groups targeted. If the hypothesis that this study attempts to support is true, the racial composition of the regime will determine whether the regime targets a specific racial group.

Case selection

This study looks at all of the states with autocratic regimes during the post-cold war not experiencing a civil war, as measured by the UCDP/PRIO database (*Gleditsch et al. 2002, Themnér & Wallensteen 2014*). It does this in order to avoid states whose regimes may have been funded or otherwise supported by the United States or the U.S.S.R. during the cold war era.

Out of the group of countries that were not categorized as going through a civil war during the post-cold war era, the ones chosen for this study have to be categorized as authoritarian regimes, meaning that the incumbent leader or party has not lost an election. (*Escriba-Folch & Wright, 2012*),

During these countries' times as dictatorships, only Venezuela and Mexico from 1990 to 1994, and Cuba were not experiencing higher threshold civil wars.

To determine disparities or consistencies between ethnically homogeneous and heterogeneous security leaderships, this study chooses one country whose leadership is heterogeneous, and one whose leadership is homogeneous. Based on these criteria, the Latin

American countries chosen for this study are Venezuela and Mexico, two countries that have experienced state-sponsored violence throughout the regime.

Data Gathering

In order to capture the groups that are underrepresented in each country, this study uses the *Ethnic Power relations 3.0 dataset (EPR3)* which codes for ethnic, linguistic, religious, racial groups; access to power; times of conflict; how much power political leaders held; and political discrimination throughout 157 countries from 1946 to 2010. The data set will be used in order to record the relevance and representation of racial groups in Mexico and Venezuela.

UCLA's *Ethnic Power Relations* dataset's use of the term ethnicity includes "ethnolinguistic, ethnosomatic (or "racial"), and ethnoreligious groups". It categorizes an ethnic group as "politically relevant" if their interests are nationally-served by one or more active political organizations, or if the group's members experience "systematic and intentional" political discrimination, or targeted exclusion. The dataset does not code the variance in an ethnic group's representation by political groups or the various leaders that represent the same group. It is assumed that with political mobilization or intentional ethnic discrimination in the political arena, comes political relevancy (*Wimmer, Cederman, & Min, 2009*). If the group is politically relevant, it is likely to receive acknowledgement from the state either as a threat or as a group that needs government support.

The second dataset that will be used is the *Minorities at Risk* dataset. It will be used to determine which racial groups throughout Mexico and Venezuela pose any kind of threat to the autocratic regime and what kind of discrimination they are facing within the state.

The *Minorities at Risk* dataset's political discrimination scale (POLDIS*) goes from 0 to 4, with zero meaning that there is no political discrimination

The economic discrimination scale (ECDIS*) goes from 0 to 4, with 0 being no discrimination.

I measure the threat the group poses as the strength of their grievance against the state and their ability to act on this grievance against the state. For grievances by the minority group, the MAR dataset reports the highest grievance level the group representatives express., as reported values are from group leader "statements and actions," as well as what third parties have observed.

Protests (PROT*) range from 0 to 5. The scale zero means that there were no reported protests.

Rebellions (REB*) range from 0 to 7. The MAR dataset's coding of repression (REPNVIOL***) encompasses group members engaged in "nonviolent collective action (e.g., politicians, human rights leaders, nonviolent protesters, etc.), ranging from 0 to 5.

This study will be focusing on Venezuela during Maduro's rule (2013 – present) and Mexico during 1990 to 1994, using information from various news sources collected by the *Center for Economic and Policy Research (CEPR)* for Venezuela, and Guillermo Trejo's *Popular Movements in Latin Autocracies: Religion, Repression, and Indigenous Collective Action in Mexico (2012)* for Mexico, excluding drug-trade related violence. Data from the CEPR and Trejo were used to record state-sponsored repression and violence against civilians. The information served as the dependent variable of this study.

Findings

Venezuela

Racial Underrepresentation

Two significant politically-active groups the Minorities at Risk (*2009*) dataset focuses on in Venezuela have been Indigenous and Afro- Venezuelans.

Afro-Venezuelans

According to the Ethnic Power Relations (*2009*), Afro-Venezuelans are an ethnically relevant minority group, but are categorized as powerless. According to the MAR project (*2009*), Afro-Venezuelans suffer political discrimination, mostly social exclusion, thus they are at risk for protest. The discrimination they face is not institutionally ingrained, but social, such as society labeling them as of lower social class and intelligence.

The most prevalent issue that Afro-Venezuelans face is the lack of economic opportunities (ECGR06 = 2). Low levels of governmental representation and participation in decision-making has linked political issues to these economic issues. Afro-Venezuelans have come to occupy offices appointed by the president, civil service jobs and academic posts, however the majority face discrimination at the social level, underrepresentation at the political level, and remain below the level of the mestizos, the "average" in Venezuela (ECDIS06 = 3, POLDIS06 = 3). Although Afro-Venezuelans have protested in recent years, the instances were in support of President Hugo Chavez, and now President Maduro (*MAR, 2009*).

Indigenous Peoples of Venezuela

According to the Ethnic Power Relations dataset, indigenous peoples of Venezuela are categorized as an ethnically relevant, but powerless, minority group (*Wimmer, Cederman, & Min, 2009).* According to MAR, many Venezuelan indigenous are malnourished and are not provided with educational and health or public hygiene services, such as sewage and clean water (ECGR06 = 2). According to the MAR project, Venezuela's indigenous groups, who comprise 2% of the Venezuelan population, possess a low risk for rebellion, mostly practicing nonviolent protests directed towards United States Caribbean military operations and the Venezuelan government, though they supported President Chavez, and now support President Maduro (*MAR, 2009*).

Cases of Violence and Repression

According to the data gathered from the news-sources provided by the *Center of Economics and Policy Research,* the majority of the people killed during the recent protests against President Maduro were not mostly of a specific racial makeup, but were reported to be mostly of middle-class backgrounds, with the violence occurring in mostly middle-class neighborhoods.

Dates and Locations of Fatal Events Connected to Protest in Favor and Against Venezuelan President Nicolas Maduro

DATE	LOCATION
12-Feb	Caracas
12-Feb	Candelaria Parish in Caracas
12-Feb	Chacao, Caracas
18-Feb	Carupano, Sucre
18-Feb	Carabobo
19-Feb	Carabobo
20-Feb	Herman Garmendia de Barquisimeto, Lara
20-Feb	Chacao
21-Feb	Romulo Gallegos Avenue, Caracas
21-Feb	Las Americas, Merida
21-Feb	Candelaria Parish in Caracas
22-Feb	Tazaja, Carabobo
23-Feb	Tachira, San Cristobal
24-Feb	Francisco de Miranda neighborhood, Maracaibo
24-Feb	Fundacion de Cagua sector, Sucre, Aragua
24-Feb	Avenida Espana, San Cristobal
25-Feb	Valencia, Carabobo
25-Feb	El Limon
28-Feb	Valencia
3-Mar	Altamira Sur, Chacao
4-Mar	Rubio, Tachira
6-Mar	Los Ruices, Caracas
6-Mar	Los Ruices, Caracas
7-Mar	N/A
9-Mar	Merida
10-Mar	San Cristobal
12-Mar	La Isabelica, Carabobo
12-Mar	Monango, Naguanagua
12-Mar	La Isabelica
16-Mar	Maracay, Aragua
18-Mar	Montalban neighborhood, Caracas
19-Mar	Tachira
21-Mar	San Cristobal
21-Mar	Valencia
22-Mar	Merida
23-Mar	Los Nueves Teques, Guaicaipuro
24-Mar	Merida

Information gathered from the Center of Economics and Policy Research

Mexico

Racial Underrepresentation

Cases of Violence and Repression

In 2006, the National Human Rights Commission (CNDH) offices in Mexico City were occupied as a way of protesting the violence and poverty encountered in Oaxaca.11 people died due to the Popular Revolutionary Army's (EPR), attack on Huatulco in August 1996. The military and police have caused the deaths of 20 to 30 COCEI members since 1974. According to MAR, recent acts of opposition has been nonviolent (PROT01 = 5, PROT02 = 4; PROT03 = 2). However, protests that erupted in Oaxaca in 2006 became violent (PROT06 = 4; REPNVIOL06 = 4) *(MAR, 2009).* While there have been no cases of rebellions reported within recent years (REB04-06 = 0), land disputes between Zapatista and non-Zapatista supporters have increased and protests have continued (PROT04 = 3; PROT05 = 2; PROT06 = 3) *(MAR, 2009).*

According to data gathered by Trejo (*2012*), Mexico's indigenous protest began increasing from 1990 to 1992, dipped in 1993, then significantly increased during 1994. Protesting and rebellions in 1994 during the Chiapas Conflict were mostly against the "PRI-controlled local and state governments," which were corrupt and practiced electoral fraud, the lack of aid provision, were driven by claims of corruption and electoral fraud, state failure to provide promised aid, protection of communal indigenous lands, as well as "expressions of solidarity with the Zapatista rebels" (PROT94-00 = 5; REB94-00 = 6)." (*MAR, 2009*).

Trejo (*2012*) also gives data regarding which security forces in Mexico are called in during times of indigenous repression. During instances of indigenous repression, the armed forces and the local police increased and decreased at the same times. However, during the 1990s, the police called in by the state to repress the indigenous populations declined, while the army that was called on to repress indigenous Mexicans increased. Being of a similar racial makeup as the civilians in the area means that the local police are more likely to have local racial ties. The higher the ranking, however, the more homogeneous the leadership is. This shows that the state may rely more on a security force that is not racially tied to a minority group,

Repression by Security Groups

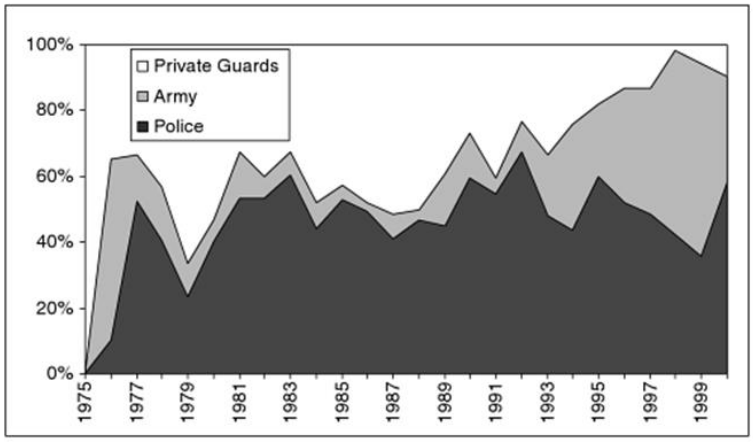


FIGURE 4.2. Repression against indigenous populations by perpetrator (relative contribution).

Source: Guillermo Trejo's Popular Movements in Autocracies (2012)

Discussion

This study expected to find that homogeneous leadership is more likely to racially target civilians than a heterogeneous leadership. In order to see which groups provide each state with the most threat, this study looked at racial groups that lack representation. While identifying the racial groups that are most underrepresented, it found that Afro-Venezuelans and Indigenous Venezuelans face social and economic discrimination. Although this is the case, they do not pose as large a threat due to their support of the state's leader according to information from the *Minorities at Risk* project showing Afro-Venezuelans and Indigenous supported Chavez throughout his time of power. However, underrepresented groups do oppose certain governmental issues, such as the lack of Afro-Venezuelan representation in high government ranks, and the endangerment of the indigenous' lifestyles and traditions by the government (*MAR, 2009*). When compiling data on the victims of violence during the recent protests in Venezuela, the victims were not from the underrepresented groups looked at in this study, but rather from a middle-class background (*CEPR, 2014*). This is likely due to a targeting of certain socio-economic groups, rather than of specific racial or ethnic groups.

Indigenous Mexicans, on the other hand, have had a history of rebellion against the government, its discrimination against this group, and its leadership. When looking at Mexico's Chiapas Conflict, it is clear that the military branch doing most of the repression against these indigenous groups is the army, rather than the local police (*Trejo, 2012*). This may be due to security forces at the local level being more heterogeneously comprised of Mexicans of European, mestizo, and indigenous backgrounds. According to Vinson (*1995*), the higher rankings of the Mexican military, along with higher positions in society, were held for white Mexicans, making it more homogeneous and exclusive of non-whites at the higher levels. Taking that into consideration, the fact that during times of indigenous conflict, homogeneous forces are called on to use repressive means demonstrates that the ethnically homogeneous security force is more likely to repress groups outside of their ethnic group.

It is important to note, however, that this study only focuses on autocratic regimes throughout the post-cold war era. This means that dictatorships before and during the cold war were not studied. Another limitation to this study is the fact that of the two countries compared, not all times of violent repression were examined. Only deaths during protesting in favor of and against Venezuelan President Nicolas Maduro were recorded, as well as limited information regarding indigenous rebellion and protesting in Mexico's southern Chiapas region.

Conclusion

After gathering data from various datasets, this study's hypothesis is supported by data showing that during times of repression, an ethnically homogeneous security force is more likely to be trusted by the state to repress a population that is outside of their own racial group. This was apparent in Mexico, during the Chiapas conflict during the 1990s, when Mexico repressed indigenous rebellions with the use of the army, which is expected to be more homogeneous, rather than with the police, which is expected to be more heterogeneous. When the leadership is more heterogeneous, however, the security forces may use something else as an indicator for possible threat against the regime. As in Venezuela's case during protests in support or opposition of President Maduro, socioeconomic class was the common theme among those who were killed, rather than race. This may be an indicator that in a state with a heterogeneous

leadership, a non-racial indicator, such as socioeconomic status or region, may be used in place of race or ethnicity as an indicator of probable threat to the regime.

References

Dina M Horwedel. (2005). *Neither Enemies Nor Friends*. Fairfax: Cox, Matthews & Associates, Inc.

Duff, E. A., McCamant, J. F., & Morales, W. Q. (1976). *Violence and repression in latin america: A quantitative and historical analysis.* New York: Free Press.

Center for Economic and Policy Research (CEPR). Venezuela: Who Are They and How Did They Die? http://www.cepr.net/index.php/blogs/the-americas-blog/venezuela-who-are-they-and-how-did-they-die-new

Escriba-Folch & Wright, J. (2012). Leadership-Security Ties Dataset.

Franklin, James C. (2009). "*Contentious challenges and government responses in Latin America*." Political Research Quarterly 62(4). 700-714.

Gleditsch, Nils Petter, Peter Wallensteen, Mikael Eriksson, Margareta Sollenberg, and Håvard Strand (2002) Armed Conflict 1946-2001: A New Dataset. *Journal of Peace Research* 39(5).

Graham, R., Skidmore, T. E., Helg, A., Knight, A., & American Council of Learned Societies. (1990). *The idea of race in Latin America*, 1870-1940. Austin: University of Texas Press.

Lazarev, V., & Gregory, P. (2003). Commissars and cars: A case study in the political economy of dictatorship. Journal of Comparative Economics, 31(1), 1-19. doi:10.1016/S0147-5967(02)00015-X

Mele, C. & Siegel, D. (2014). *Identifiability: State Repression and the Onset of Ethnic Conflict.*

Minorities at Risk Project. (2009). "Minorities at Risk Dataset." *College Park, MD: Center for International Development and Conflict Management.* Retrieved from http://www.cidcm.umd.edu/mar/data.aspx on: 07/13/2014

Nagengast, C. (1994). *Violence, terror, and the crisis of the state*. Annual Review of Anthropology, 23, 109-136. doi:10.1146/annurev.anthro.23.1.109

Posen, B. (1993). "The security dilemma and ethnic conflict." Survival 35(1). 27-47.

Themnér, Lotta & Peter Wallensteen (2014) Armed Conflict, 1946-2013. *Journal of Peace Research* 51(4).

Trejo, G. (2012). *Popular movements in autocracies: Religion, repression, and indigenous collective action in Mexico.* New York: Cambridge University Press.

Tullock, G. (1986). Industrial organization and rent seeking in dictatorships. *Journal of Institutional and Theoretical Economics (JITE) / Zeitschrift Für Die Gesamte Staatswissenschaft, 142*(1), 4-15.

Vinson, B. (1995). Free colored voices: Issues of representation and racial identity in the colonial mexican militia. *The Journal of Negro History, 80*(4), 170-182.

Wade, P. (1997). *Race and ethnicity in Latin America*. Chicago, Ill: Pluto Press.

Wade, P. (2009) *Race in Latin America, in A Companion to Latin American Anthropology* (ed D. Poole), Blackwell Publishing Ltd., Oxford, UK. doi: 10.1002/9781444301328.ch9

Wimmer A., Lars-Erik Cederman and Brian Min. (2009). "Ethnic politics and armed conflict. A configurational analysis of a new global dataset", in *American Sociological Review* 74(2). 316-337,