The Penn State McNair Journal

Summer 2008, Volume 15

THE PENN STATE MCNAIR JOURNAL

Table of Contents

McNair Scholar Articles

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 fifteenth issue of the Penn State McNair Journal. We congratulate the 2008 Penn State McNair Scholars and their faculty research advisors! This journal presents the research conducted in the summer of 2008 by undergraduate students from Penn State who are 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 Graham Spanier, President of Penn State University; Rodney Erikson, Provost of Penn State University; Eva Pell, Senior Vice President of Research and Dean of the Graduate School; and Evelynn Ellis, the former Senior Director of the Office of Graduate Educational Equity, 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.

Teresa Tassotti
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, a dissemination program, and a training program for TRIO staff. McNair programs are located at 188 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 11 TRIO Programs at Penn State comprise six of the nine TRIO programs. There are two Educational Opportunity Centers, one in Philadelphia and the other serving southwestern Pennsylvania, two Talent Search Programs serving western Pennsylvania and the city of York, Ronald E. McNair Scholars Program, four Student Support Services Programs, Upward Bound, and Upward Bound Math & Science. These programs annually serve more than 6,000 students, from 6th graders through adults, all with clear potential for academic success. The programs operate at the following Penn State campuses: University Park, Wilkes-Barre, Greater Allegheny, and the Pennsylvania Institute of Technology. The programs also operate 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 178 students earn their baccalaureate degrees. Of these graduates, 146 or 82 percent have gone on to graduate school at institutions across the country and overseas. As of September 2008, 30 or 17 percent have earned their doctoral or professional degrees and another 68 or 38 percent have earned their master's degrees only. Currently, there are 55 or 31 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, Cornell, DePaul, Harvard, Howard, Indiana University-Bloomington, John Hopkins, New York University, Ohio State, Penn State, Purdue, Rice University, Stanford, Temple, UCLA, University of California-Berkeley, University of California-Davis, University of Chicago, University of Maryland-College Park, University of Michigan, University of North Carolina-Chapel Hill, and University of Pennsylvania, to name just a few.

Summary 2008 McNair Scholars and Program Staff

Standing (left to right): Danielle Forbes, Marquita Stokes, Tiffany Velez, Jennifer Mulcahy-Avery, Patrick Reck, Blake Garcia, Janay Jeter, Victoria Jackson, Judy Banker (Staff Assistant)

Sitting (left to right): Damaris Fuster, Jacqueline Cauley, Robert Vary, Penelope Chambers, Teresa Tassotti (Program Director)

Missing from photo: Diana Barrantes, Genevieve Miller

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)

McNair Alumni on the Move

We congratulate our recent graduates and are very proud of their accomplishments. We also extend congratulations to those Penn State McNair alumni who have earned their graduate degrees as well as those alumni currently enrolled in graduate studies.

At the graduate level...

Mimi (Abel) Hughes (PSU 2002)	M.S., University of California-Los Angeles
	Ph.D., University of California-Los Angeles
Juan Abreu (PSU 2002)	J.D., Rutgers University
Felix Acon-Chen (PSU 2004)	M.S., Stevens Institute of Technology
Taimarie Adams (PSU 2003)	J.D., Harvard University
Karla (James) Anderson (VSU 1999)	M.S., Central Michigan University
Omotayo Banjo (PSU 2004)	Ph.D., Penn State University
Angelo Berrios (PSU 2000)	M.S, Joseph's University
Aaron Brundage (PSU 1995)	M.S., Penn State University
	Ph.D., Purdue University
Jose Buitrago (PSU 1995)	M.L.A., Harvard University
Sherese Burnham (PSU 1999)	M.A., University of Central Florida
Sofia Cerda-Gonzalez (PSU 1999)	D.V.M., Cornell University
Trinaty Crosby (PSU 2005)	M.S.W., Howard University
Evelyn Cruz (VSU 1996)	M.S., University of Virginia
Natasha Deer (PSU 1995)	M.A., Florida State University
Alicia DeFrancesco (PSU 1997)	M.B.A., Babson College
Lurie Daniel (PSU 2000)	J.D., New York University
Jorge Delgado (PSU 2004)	M.S., Purdue University
Eve Dunbar (PSU 1998)	Ph.D., University of Texas-Austin
Carol Elias (VSU 1997)	M.Ed., Virginia State University
Mark Elwell (PSU 2002)	M.S., Cornell University
Natasha Faison (PSU 1999)	M.S., Penn State University,
	M.A., University of Michigan
Max Fontus (PSU 1999)	Ph.D., Indiana University-Bloomington
Michael Godeny (PSU 2002)	Ph.D., University of Florida
Cristina Gonzalez (PSU 1999)	M.D., Albert Einstein Medical School
Sherie Graham (PSU 2002)	M.P.H., University of Michigan
Derek Gray (VSU 1998)	M.L.A., SUNY-Albany
	M.A., SUNY-Albany
Mark Harewood (VSU 2000)	M.A., Webster University
Janet Harris (PSU 1996)	M.Ed, Duquesne University
Angela Hess (PSU 1998)	Ph.D., University of Iowa
Priscilla Hockin-Brown (PSU 1996)	M.S., Michigan State University
	Ph.D., Rutgers University
Dustin Holloway (PSU 2002)	Ph.D., Boston University
Marissa (Graby) Hoover (PSU 2000)	M.S., Temple University
Meng He (PSU 2002)	M.S., American University
Jeffrey Himes (PSU 1997)	M.A., West Virginia University
Alisa Howze (PSU 1994)	Ph.D., Texas A&M University
Andrea Jones (VSU 1998)	M.A., Virginia State University
Michelle Jones-London (PSU 1996)	Ph.D., Penn State University

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Leshawn Kee (VSU 1998)	M.A., Regents University
Haroon Kharem (PSU 1996)	Ph.D., Penn State University
Carrie (Hippchen) Kuhn (PSU 2001)	M.A., Stanford University
Judy Liu (PSU 1995)	M.S., University of California-Berkeley
	Ph.D., University of California-Berkeley
LaShawne Long-Myles (PSU 2001)	M.Ed., Xavier University
Lanik Lowry (PSU 2002)	M.B.A., University of Maryland-College Park
	M.S., University of Maryland-College Park
Charmayne Maddox (PSU 2004)	M.Ed., Penn State University
	M.Ed., Chestnut Hill College
Lourdes Marcano (PSU 1995)	M.B.A., University of Tennessee
Debra Marks (VSU 1996)	M.S., University of Virginia
Leanna Mellott (PSU 2000)	Ph.D., Ohio State University
Robert Miller (PSU 1999)	Ph.D., University of Kentucky
Bethany Molnar (PSU 1998)	M.S., Northeastern University
Nicole Morbillo (PSU 1998)	Ph.D., New York University
Ndidi Moses (PSU 2000)	M.A., Penn State University,
	J.D., University of Connecticut
Rashid Njai (PSU 2000)	M.P.H., University of Michigan
	Ph.D., University of Michigan
Julio Ortiz (PSU 2002)	Ph.D., Penn State University
Robert Osmanski (PSU 1995)	M.S., Penn State University
Hui Ou (PSU 2005)	M.S., Cornell University
Mark Palumbo (PSU 2000)	M.S., Wright State University
	Ph.D., Wright State University
Tracie Parker (VSU 2003)	M.A., Ohio State University
Franche Pierre-Robinson (VSU 2002)	M.Ed., University of Illinois-Chicago
Caryn Rodgers (PSU 2000)	Ph.D., St. John's University
Lilliam Santiago-Quinones (PSU 1998)	M.Ed., Bowling Green State University
Thomas Shields (PSU 1998)	M.A., Penn State University
Christie Sidora (PSU 2000)	M.A., Duquesne University
Andrew Snauffer (PSU 1996)	M.S., Michigan Technical University
Melik Spain (VSU 1996)	M.S., Virginia Tech University
Anthony Spencer (PSU 1999)	Ph.D., Northwestern University
Kashra Taliaferro (PSU 2003)	M.Ed., University of Maryland-College Park
Shawyntee Vertilus (PSU 1998)	M.P.H./M.D., New York Medical College
Patrice White (VSU 2001)	M.A., University of Maryland-College Park
Kahlil Williams (PSU 2001)	M.A., University of Pennsylvania
	Ph.D., University of Pennsylvania
Romon Williams (VSU 1995)	M.S., Wake Forest University
Wendy Williamson (PSU 1995)	M.B.A., Penn State University
Kenya Wright (VSU 1997)	M.S., North Carolina State University
Heneryatta Ballah (PSU 2004)	M.A., Ohio State University, now pursuing Ph.D. at same institution
Michael Benitez (PSU 2001)	M.Ed., Penn State University, now pursuing Ph.D. at Iowa State University
Laurian Bowles (PSU 1999)	M.A., University of London,
	M.A., Temple University now pursuing Ph.D. in Anthropology at same institution
Debbie Charles (PSU 001)	M.S., University of Maryland-College Park now pursuing V.M.D. at Tuskegee University
Catherine Crawford (PSU 1996)	M.Ed., Central Michigan University now pursuing

	graduate studies at Cappella University
Latia Eaton (VSU 2003)	M.S.W., University of Baltimore now pursuing second masters at St. Mary's Seminary
Felecia Evans-Bowser (PSU 2002)	M.S., Texas Tech University, now pursuing Ph.D. at same institution
Tiana Garrett (VSU 2001)	Ph.D., University of North Carolina-Chapel Hill now pursuing MPH at same institution
Antoinette Gomez (PSU 1994)	M.S., Clark-Atlanta University now pursuing Ph.D. at University of Denver
Atiya Harmon (PSU 2002)	M.S., University of Pennsylvania now M.Ed at Chestnut Hill College
Maria Gutierrez-Jaskiewicz (PSU 2005)	M.A., University of California-Berkeley now pursuing Ph.D. in Middle East Studies at same institution
Angel Miles (PSU 2003)	M.A., University of Maryland-College Park, now pursuing Ph.D. at same institution
Zakia Posey (PSU 1999)	M.S., Michigan State University, now pursuing Ph.D. at same institution
Kenya Ramey (VSU 2006)	M.A., Temple University now pursuing Ph.D. in African-American Studies
Kristin Rauch (PSU 2004)	M.S., University of California-Davis now pursuing Ph.D. at same institution
Cavin Robinson (PSU 2002)	M.A., DePaul University now pursuing Ph.D. in Philosophy at same institution
Sassy Ross (PSU 2001)	M.F.A., New York University now pursuing Ph.D. in English at University of Utah
Steven Thompson (PSU 1997)	M.S., Indiana University-Purdue, now pursuing Ph.D. at Clemson University
Anthony Paul Trace (PSU 2004)	M.S., University of Virginia now pursuing Ph.D at same institution

At the undergraduate level…

Lauren Kessler (PSU) May 2008
Robert Ksiazkiewcz (PSU) May 2008
Andrae Laws (PSU) May 2008
Amber Ortega (PSU) May 2008
Luis Ocampo (PSU) May 2008
Fawn Patchell (PSU) December 2007
Anjana Patel (PSU) May 2008
Sue Annie Rodriguez (PSU) May 2008
Angelica Smith (PSU) December 2007
Scott Test (PSU) May 2008
Katherine Wheatle (PSU) May 2008
Daniel Zaccariello (PSU) May 2008

On to graduate school in Fall 2008…

Robert Ksiazkiewcz now pursuing graduate studies in Public Administration at the University of Pittsburgh
Amber Ortega now pursuing graduate studies in Atmospheric Sciences at University

of Colorado

Fawn Patchell now pursuing graduate studies in Nutrition Sciences at Penn State University

Anjana Patel now pursuing graduate studies in Public Health at Drexel University

Sue Annie Rodriguez now pursuing graduate studies in Human Development and Family Studies at Arizona State University

Scott Test now pursuing graduate studies in Library Sciences at Clarion University

Katherine Wheatle now pursuing graduate studies in Public Health at Emory University

Daniel Zaccariello now pursuing graduate studies in Political Science at Rice University

In graduate school as of Fall 2008...

Luis Agosto (PSU 2005)	University of Pennsylvania (Virology)
Christopher Arlene (PSU 2004)	Harvard University (Public Policy)
Saalim Carter (PSU 2007)	University of Chicago (History)
Dipnil Chowdhury (PSU 2007)	University of Pennsylvania (Systems Engineering)
Andra Colbert (VSU 2005)	Johns Hopkins University (Education)
Michael Collins (VSU 2005)	Howard University (Medicine)
Latoya Currie (VSU 1999)	Virginia Commonwealth University (Education)
Alana Curry (VSU 2007)	Tuskegee University (Veterinary Medicine)
Jennifer Geacone-Cruz (PSU 2002)	Bunka So-en Daigaku University (Fashion Design)
Oneximo Gonzalez (PSU 2007)	University of Pittsburgh (Biomedical Engineering)
Kathy Goodson (VSU 2005)	University of Maryland-College Park (Biochemistry)
Dennis Harney (PSU 1993)	University of Pennsylvania (Governmental Administration)
Paula Henderson (PSU 2005)	Barry University
Juliet Iwelumor (PSU 2006)	Penn State University (Biobehavioral Health)
Irene Karedis (PSU 2006)	Institute of World Politics
Renee Killins (PSU 2007)	Purdue University (Life Sciences)
Chong Mike Lee (PSU 2007)	Penn State University (Molecular Biology)
Edward Mills (VSU 2003)	University of Illinois at Urbana-Champaign (History)
Shartaya Mollett (PSU 2007)	University of Pittsburgh (Social Work)
LaShauna Myers (PSU 2003)	University of Pennsylvania (Higher Education)
Tiffany Polanco (PSU 2004)	Rutgers University (Animal Science)
Natalie Ragland (PSU 2001)	Ross University (Veterinary Medicine)
Adriana Segura (PSU 2006)	Northwestern University (Medicine)
Kedesha Sibliss (VSU 2003)	Howard University (Medicine)
Luisa Soaterna (VSU 2004)	Virginia Commonwealth University (Health Administration)
Joshua Walker (PSU 2007)	University of California-Davis (Atmospheric Sciences)
Michele Wisniewski (PSU 2004)	Massachusetts College of Pharmacy (Pharmacy)
Robert Allen Young (PSU 2007)	University of Pittsburgh (Higher Education)

Contribution of BK Virus miniT Protein to Viral Oncogenic Activity

Diana P. Barrantes, McNair Scholar, The Pennsylvania State University

Faculty Research Advisor: Dr. Richard J. Frisque
Professor of Molecular Virology
Department of Biochemistry and Molecular Biology
Eberly College of Science
The Pennsylvania State University

Introduction:

BK Virus (BKV), a human polyomavirus, was first isolated in 1971 from a renal transplant patient who was shedding inclusion-bearing epithelial cells in his urine (Gardner et al., 1971). More than 80% of the adult human populations test positive serologically for BKV and most primary infections occur in childhood (Gardner et al., 1971). Clinical pathologic studies suggest that in immuncompetent hosts, the virus persists in many organs after the primary infection, but the asymptomatic infection mainly involves the kidneys and peripheral blood leukocytes (Ashan and Shah, 2005; Bam, 2005; Tognon, 2003). On the other hand, in patients with an immunocompromising disease, especially involving T cell deficiency, activation of the virus occurs (Sundsfjord et al.,1994; Markowitz et al., 1993). BKV has been associated with hemorrhagic cystitis in bone marrow recipients, and BKV nephropathy, the major cause of graft dysfunction and rejection in renal transplant recipients (Hashida et al., 1976; Binet et al., 1999; Nickeleit et al., 2003). BKV is also an oncogenic agent that induces tumors in rodents, and has been associated with human cancer (Tognon, 2003).

BKV is a non-enveloped virus with a double stranded, circular DNA genome that encodes two regulatory proteins, large T and small T (TAg and tAg, respectively). These proteins regulate viral replication and promote transformation of non-permissive cells (Moens et al, 1995). Recently, a third BKV protein was discovered, which is hypothesized to influence oncogenic transformation; this protein is called miniT (Prins, Bam and Frisque, unpub. data).

My project is designed to test whether the miniT protein plays a role in the transformation process. I am utilizing two strains of BKV, pBKV(AS) and pBKV(WT9). Both wild type and mutant forms of these strains will be examined for the ability to induce transformation of the rodent cell line, Rat2, using a dense focus assay. Initial studies were performed with pBKV(AS), but I will repeat this work with pBKV(WT9) because it transforms the rat cells more efficiently, thus allowing us to observe greater differences in transformation potential of wild type versus miniT mutant virus.

Methods:
Viruses / DNAs

To initiate this study, restriction enzyme digests were performed on pBKV(AS), pBKV(WT9), and clones pBKV(WT9)- BMSKS # 5 and # 7 to identify the direction in which the pBKV(WT9) DNA has been inserted in the Bluescript vector. Twelve 20 µl DNA samples were prepared for digestion, three samples (pBKV(AS), pBKV(WT9),

pBKV(WT9)-BMSKS #5) were left uncut to serve as size markers for supercoiled DNA. The enzymes utilized for the digestion were EcoRI, BamHI, and Pst I; the last two, allowed us to determine the orientation of the two viral DNAs in the Bluescript Vector, a high copy number plasmid. One microliter(µl) of the appropriate digestion buffer was added per sample; for those samples being digested by Bam HI, an additional 1 µl of BSA was added to enhance enzyme activity. The following table indicates the amount of DNA, double distilled water (ddH$_2$0), enzyme, buffer, and 10X loading buffer utilized per sample to make a 20 µl solution:

	pBKV(AS)			pBKV(WT9)				pBKV(WT9)-BMSKS # 5				pBKV(WT9)-BMSKS # 7		
Samples	Uncut	1	2	3	Uncut	1	2	3	Uncut	1	2	3	1	2	3
DNA	1	1	1	1	4.8	4.8	4.8	4.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5
ddH2O	17	16	16	16	13.2	12.2	12.2	12.2	17.5	17	16.5	16.5	16.5	16.5	16.5
Enzyme Buffer	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1
EcoRI	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0
Bam HI	0	0	2	0	0	0	2	0	0	0	2	0	0	2	0
Pst I	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1

*All volumes are in microliters.

Restriction enzyme digests were performed under the conditions recommended by the manufacturer (New England Biolabs). The samples were electrophoresed in a 1% agarose gel containing the intercalating dye ethidium bromide at 120V for 30-60 min. DNA fragments were visualized by UV light and photographed.

The second step in this project was to complete the nucleotide sequence analysis of the pBKV(WT9) DNA that had been initiated earlier by other members of the laboratory. To do so, a sequencing primer was designed [5'—CTG GTG TAG ATC AGA GGG—3'] and sequence analysis of the pBKV(WT9) DNA was performed by the Penn State DNA sequence facility. The pBKV(WT9) sequence obtained was compared to the pBKV(AS) sequence utilizing a sequencing software (NCBI Nucleotide Blast), since the DNA sequence for these two viruses was expected to differ by about 50-100 nucleotide base pairs.

Mutagenesis

In order to produce the G to A mutation that would disrupt splicing of the miniT mRNA, the following PAGE- purified forward and reverse primers were utilized, respectively: BKSDMf 5'-CCA AAA AAA AAA GAA A**A**G TAG AAG ACC CTA AAG AC-3' and BKSDMr 5'-GTC TTT AGG GTC TTC TAC **T**TT TCT TTT TTT TTT GG-3' (altered nucleotide underline and in bold). A PCR reaction was carried out using 1µl of *Pfu* turbo polymerase [2.5U/µl], 1µl of dNTP mix [10mM], 1µl of forward primer [3.50nMoles, 10mM], 1µl of reverse primer[5.60nMoles, 10mM], 2 µl of magnesium [Mg^{2+} 1.5mM], and 5µl of 10X reaction buffer in a 50µl reaction mix with the pBKV(WT9) [139ng/µl] template.

The PCR sample was electrophoresed on a 1% agarose gel to confirm that PCR product was generated. PCR product was then treated with Dpn I for 1 hour at 37° C to digest the wild type BKV DNA produced in bacterial cells. The original template

2

[pBKV(WT9)-BMSKS # 5],the undigested PCR product [uncut 3], and the digested PCR product [DpnI 3] were electrophoresed on an 0. 8% agarose gel to determine if most of the digested PCR product resisted Dpn I cleavage.

PCR product was transfected into competent bacterial cells. Three samples were used: pBKV(WT9)-BMSKS #5 [10ng/µl], the undigested PCR product [uncut 3], and the digested PCR product[DpnI 3]. Z competent cells [100µl] were used for each transformation. One µl of each sample was added to 100µl competent cells, and the mixture was incubated on ice for 20 minutes. Room temperature super optimal broth with catabolite (SOC) media [400 µl] was added per sample; samples were then placed for 45-60 minutes in the 37° C shaker. Each sample was plated [200µl] on two Luria-Bertani agarose with ampicillin (LB +Amp) plates and incubated overnight at 37° C. Individual colonies from the digested PCR product [DpnI 3] plate were selected and DNA was extracted using the Wizard Plus SV Minipreps DNA Purification System Kit.

To verify that the correct mutation was introduced into pBKV(WT9) DNA, the mT1 sequencing primer was designed 5'- CAG TGG TTT GGC TTA GAC C-3' and DNAs prepared from colonies 4, 5, and 6 on the digested PCR product [DpnI 3] plate were taken to the sequencing facility. Several sequencing reactions were performed to identify a DNA containing the desired sequence mutation.

Large scale preparation (maxi-prep) of DNA

Maxi-preps of pBKV(WT9) and mutant pBKV(WT9)-ΔminiT were prepared using the Quiagen maxi-prep kit. Samples were then digested with Bgl II to cleave the desired fragment of DNA from pBKV(WT9)-ΔminiT, containing the mutation, and pBKV(WT9), without the mutation. For this enzyme reaction, 10µg of pBKV(WT9) DNA and 20 µg of pBKV(WT9)-ΔminiT DNA were digested individually in a 100 µl mixture containing 4µl of Bg1 II, 10 µl of 10X buffer and appropriate amounts of ddH$_2$O. Samples were incubated for 1.5 hours, and electrophoresed on 0.8% agarose gels. The desired fragments were removed from the agarose gel and purified using The Wizard Plus Gel Purification System Kit.

Following the construction of the mutant, Rat2 cells will be transfected with wild type and mutant miniT DNAs representing both pBKV(AS) and pBKV(WT9) genomes using a calcium phosphate technique. The time of appearance of dense foci (evidence of transformed cells) will be noted and the number of foci will be counted following staining of the cells with a dye. Cells from a dense focus will be isolated with pipette tips for further analysis.

Results:

Before the enzyme digestion was performed, I electrophoresed all four viral DNAs in a 1% agarose gel to verify that the viral DNAs where in the correct vector: Bluescript as opposed to pBR322. As can be seen in Figure 1, pBKV(AS) and clones pBKV(WT9) - #5 and #7 have the same gel migration patterns, indicating that the clones were in the Bluescript vector.
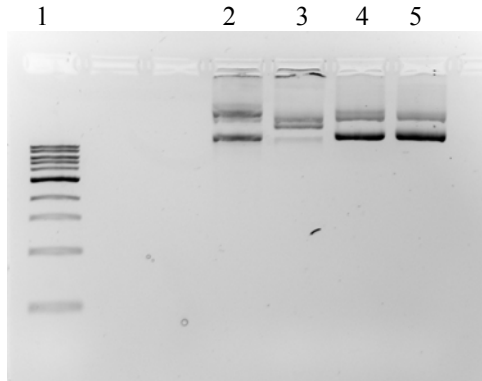
1. Marker
2. BKV(AS) ~ Bluescript
3. BKV(WT9) ~ pBR322
4. BKV(WT9) - #5
5. BKV(WT9)- # 7

Restriction enzyme digestion of pBKV(AS), pBKV(WT9), and clones pBKV (WT9) #5 and #7 with BamHI or PstI demonstrated the orientation of the clones in the vector. Figure 2 is a picture of a 1% agarose gel, through which the DNA samples were electrophoresed for one hour.

 [Fig. 2]
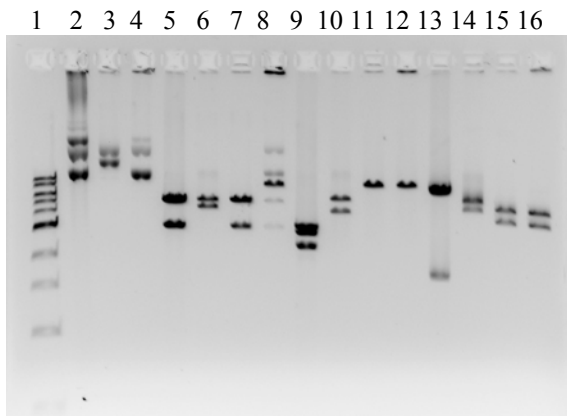
1. Marker

Uncut Samples
2. BKV (AS)
3. BKV (WT9)
4. BKV (WT9)-# 5

Cut with EcoRI
5. BKV (AS)
6. BKV (WT9)
7. BKV (WT9)-#5
8. BKV (WT9)-#7

Cut with BamHI
9. BKV (AS)
10. BKV (WT9)
11. BKV (WT9)-#5
12. BKV (WT9)-#7

Cut with Pst I
13. BKV (AS)
14. BKV (WT9)
15. BKV (WT9)-#5
16. BKV (WT9)-#7

Based on the base pair length of the Pst I enzyme cut, the orientation of vector for pBKV(WT 9) and pBKV(AS) is represented in Figure 3.
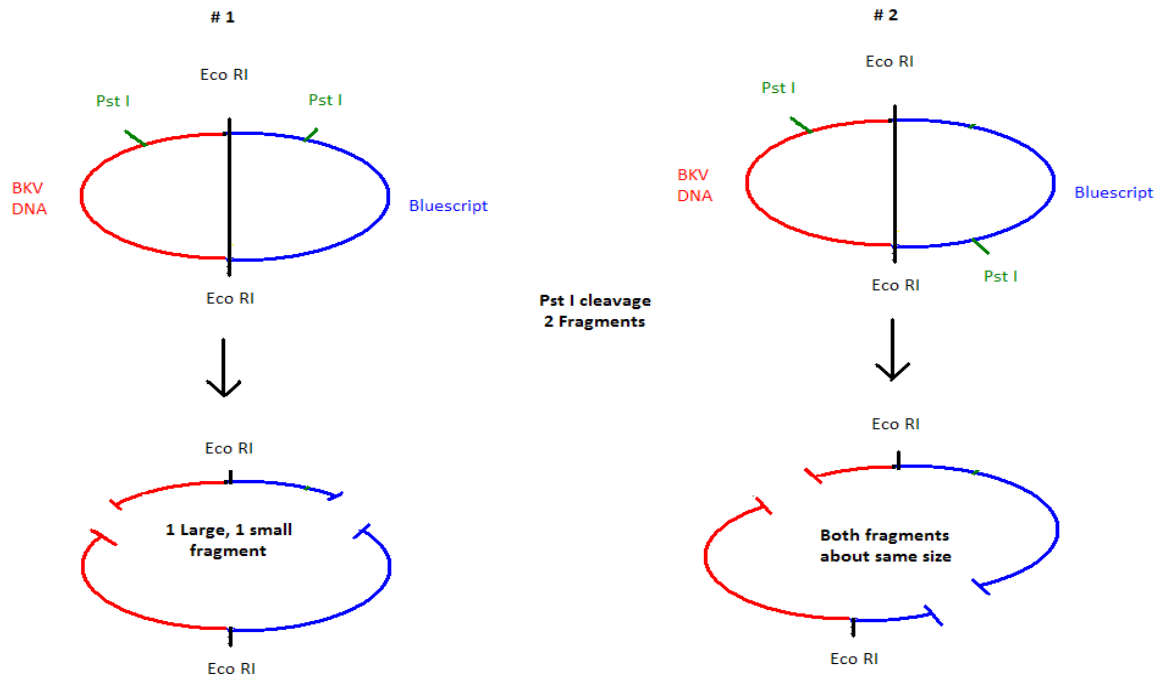
[Fig 3] The circle represents double- stranded DNA. The black line in the middle of each circle serves to separate the viral DNA (left, red line), and the Bluescript Vector (right, blue line). Depending on the orientation of the viral DNA in the vector, Pst1 cleavage yields either 2 fragments of dissimilar size (#1) or nearly equal size (#2). pBKV(AS) is oriented in the manner represented by circle 1, and pBKV(WT9) is oriented in its vector the opposite manner, represented by circle 2.

      The primary objective of my project is to abolished the expression of pBKV miniT protein by introducing a mutation at the donor splice site. This mutation was previously made in pBKV(AS), but we found wild type pBKV(AS) transforms cells inefficiently. Therefore, because pBKV(WT9) transforms better, we remade the miniT mutant in this BKV strain. By making the mutation at the donor splice site of miniT protein in pBKV(WT9), we predict that we will be able to detect differences in the oncogenic activity of the wild type and mutant viruses. To make the mutation in pBKV(WT9) we considered swapping a restriction enzyme fragment of pBKV(AS) containing the mutation into the pBKV(WT9) DNA. However, sequence differences were present in the two viral DNAs near the donor site, so the mutagenesis procedure was repeated with pBKV (WT9)-BMSKS as the template for long PCR-Site Directed Mutagenesis.

      The DNA sequence for pBKV(WT9) was completed. To permit comparisons with previously sequenced pBKV(AS) (using NCBI Nucleotide Blast). pBKV(WT9) -#5 was sequenced with primers T3 and T7, and results were compared with the parental pBKV(WT9) sequence. (12 nucleotide differences out of 5216 nucleotides). Based on the DNA sequencing results of clone pBKV(WT9) -#5 and the blast comparison to pBKV(AS), the donor-splice site for the miniT mutation was identified at nucleotide 4366.

      Verification of the mutation in pBKV(WT9) -ΔminiT was accomplished by sequencing using primers mT1, mT2, and mT3, and then, maxi-preps of the mutant and

the wild type DNAs were prepared. Since the PCR Mutagenesis technique might cause unexpected changes else where in the genome, DNAs were digested with Bg1 II to obtain the mutated fragment from pBKV(WT9)-ΔminiT and the backbone fragment from pBKV(WT9). The next step will be to ligate these two DNA fragments together to generate the final mutant containing one nucleotide change. Once ligation is completed, and the final clone is obtained the mutant and the parental DNAs will be transfected into the Rat2 cell line to test transforming ability.

Discussion:

The results generated so far indicate that the two pBKV(WT9) DNA clones, 5 and 7, were assembled correctly and are in the desired Bluescript vector for this experiment. Restriction enzyme digestions have verified the orientation of the viral DNAs within the vector sequence. Although, the initial digest did present some difficulty due either to the impurities in the original DNA sample, or to poor activity of the enzymes, follow-up digestions with newly-prepared DNA and a more optimal enzyme digest indicated that the orientations are indeed as shown in the Figure 3. The results so far have met our expectations, and we can proceed on to the next planned experiments.

Sequences comparisons revealed too many variations between pBKV(AS) and pBKV(WT9) within the region containing the mutation, which led us to use the site-directed mutagenesis method to create the pBKV(WT9)-ΔminiT mutant. We performed PCR utilizing primers BKsdm and BKsdm-r, and obtained a mutant which, after analysis, was confirmed to have the correct sequence. Maxi-preps were successfully prepared and Bgl II digestions led to the generation of the desired fragments to be used to create the final mutant construct, pBKV(WT9)- ΔminiT. Once construction of the mutant is completed, I will pursue the primary goal of determining the role of miniT protein in oncogenic transformation.

Conclusion:

To date, we have completed the sequence analysis of pBKV (WT9) and have verified that DNA clones have been properly assembled in the correct vector. Comparisons of the pBKV(AS) and pBKV(WT9) sequences have been completed and a mutagenesis strategy was devised. A pBKV miniT mutant has been obtained and verified through sequencing. Maxi-preps has been prepared and Bg1 II digestion has been performed to obtain mutant and wild type backbone fragments.

Currently, we do not know if BKV miniT protein influences viral oncogenic activity; however, once cleaved Bgl II fragments are ligated to complete the construction of the final pBKV (WT9) – ΔminiT construct, transfection of the Rat2 cell line will allow us to begin to answer this question.

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The Lone Soul

Jacqueline Cauley, McNair Scholar, The Pennsylvania State University

Faculty Research Advisor: Dr. Benjamin Hudson
Professor of History and Medieval Studies
Department of History
College of Liberal Arts
The Pennsylvania State University

A hero's life is dominated by battles and adventures, with little time for ordinary matters. No matter how supernatural a hero appears, they still have humanly needs, for example a hero needs to eat and needs money to support their lives. There is never any mention of a hero owning land to cultivate food, inheriting a large sum of money, or having any source of income. A hero does live a higher quality of life then the average person and the proof can be found in both what the literature does and does not mention.

Celtic culture is a missing aspect of European history. The Celtic hero set the standard for accepted masculine behavior. In particular, Irish heroes established the foundations for knightly chivalry of the later Middle Ages, which became the rules of conduct for the officers in modern military establishments. Finally, popular culture has embraced the cult of the hero through action films of the cinema and the comic book superhero.

Everyone is familiar with these ideas and themes surrounding a hero, but the aspects that make up a Celtic hero are different. The Celtic hero differs in certain ways such as a delicate balance between honor and aggression, an extraordinary physical beauty, and, finally limits on their actions through taboos, which often are connected with supernatural contact, both beneficial and malevolent.

This study examines the hero's development. Beginning with childhood's effect on his personality, which explains why he is different from other men, the focus will be on Irish heroes, as they are found in the literature and in the historical interpretations of modern scholars. The investigation revolves around individuals, who represent marginal societies and their names, such as Cú Chulainn, Conaire, and Finn, which are largely unknown to English-speakers.

Aspects of the heroic

A hero's life is so extraordinary that it becomes a memorial in itself. A Celtic hero represents a delicate balance between aggression and honor. Honor and aggression act as a counterbalance. When the balance is disrupted, extreme aggression becomes uncontrollable. Once it takes control of the hero, he becomes feared by enemies and allies alike. Honor alone quells the aggression. For example, in the "Boyhood Deeds" of the hero Cú Chulainn, his temper is raging when he returns home from his first battle, fighting for the men of Ulster. King Conchobar of Ulster realizes that if Cú Chulainn's temper is not calmed, then his people are in extreme danger. The Ulstermen concoct a plan that exploits Cú Chulainn's extreme honor, by having the women of Ulster bare themselves and march out to Cú Chulainn. This plan combined with three consecutive

baths returns Cú Chulainn back to a normal state of being. (Cross, 151) The balance between honor and aggression are restored and life can continue on.

Physical aspects also have a role to play in the making of a hero. Their beauty is almost a cliché in literature. The descriptions of a hero include descriptions of everything from height to eye color and physical strengths. Cú Chulainn has "kingly eyes," with pearls for teeth and is the "comeliest of the men of Erin (Cross 154 and 156)." The Celtic hero Finn, the leader of the warrior band or *Fían* in the series of tales known as the "Hero Cycle of Finn Mac Cool," is described as "tall, fair-haired…with broad shoulders (Mackillop, 232)." In "The Boyhood Deeds," Cú Chulainn is able to defeat a hundred and fifty boys trained in warfare with his bare hands, showing off his amazing physical dexterity and strength (Cross, 138).

Taboos play a large part in the development and actions of the Celtic hero in a way that is almost unique from western traditions. These prohibitions were taken very seriously in Celtic society as demonstrated by literature. The taboos not only helped guide the heroes in life but also helped to prevent their deaths. Violation of taboos leads to disaster. In several cases a hero deliberately breaks a taboo even though he knows it will lead to his death. When Conaire, the anti-hero of "The Destruction of Dá Derga's Hostel," slowly broke all of his taboos, it led him closer to his death one step at a time. Prior to his final battle, Cú Chulainn was forced to break his taboo not to eat dog flesh.

Taboos can limit the actions of a hero, often for his benefit, and can be placed on a hero at anytime from before birth to other life changing moments. Conaire has a taboo placed on him by his otherworldly animal family that he cannot hunt birds, which protect those uncanny beings in the guise of birds (Cross, 96). His supernatural origin and the advice from his avian kinsmen help him to receive the kingship of Ireland. An additional series of taboos comes with his new honor, and his disregard of them leads to his inevitable doom. Taboos of protection are often the creation of a divine power and are designed to either protect the hero and or those close by, including other divine beings. The hero Diarmuid of the Cycle of Finn Mac Cool, is given a list of taboos from his foster father Angus Óg, who is often associated or believed to be the god of beauty and youth (Mackillop, 17). Angus Óg does this to protect Diarmuid in his flight from the anger of Finn. Among these taboos are that he should never sleep in the same place for more then one night and never eat, cook or sleep in the same place. (Cross, 382)

Taboos that limit behavior or force them into doing something against their will are placed on many Celtic heroes. Cú Chulainn, for example, has a taboo on him that he cannot pass a cooking hearth without joining in the meal, forcing him to eat every time he passes one (Rees, 327). A classic example comes from the story of "Diarmuid and Grainne," when the femme fatale Grainne compels Diarmuid to elope with her. Grainne puts a taboo of danger on Diarmuid that forces him to take her away from her promised husband Finn. Diarmuid must do her bidding because breaking the taboo would cause him to lose his honor (Cross, 374).

Family

One little discussed aspect of a hero is his family. An Irish family at this time did not just consist of the traditional mother, father and the children; it also consisted of uncles, aunt, grandparents and cousins. It was a system based on the larger collective group not the nuclear group. (Geary, 27) Many heroes, however, come from what is

today described as a "single parent household." In literature, unlike reality, this situation frequently has a positive connotation. Many problems arise when a child comes out of a single parent home, in Celtic society which includes inheritance issues, weak social standing and a difficult acceptance from the family.

A child of Celtic society that was from a single parent household usually had a mother present in their life. The mother had the control and rights over the children, but it is still a society based on decent through the male line, making it a patrilineal society. (Patterson, 315 & 317) The mother is rarely missing from the life of a child because it is the mother who has the control over the children. The only reason a mother may not be present in the life of her child is if she has died in childbirth or if the mother was diseased or mad (Ancient laws of Ireland, 199).

If the child's parent's relationship was kept a secret then the child would have problems being accepted by the family. Rank was based on the father's rank, so a child with an unknown father suffered the problems of lower and doubted social standing. The status of the mother did not carry over to the child. (Patterson, 312) The problem from being a child of a single parent household affected not just social standing but would also create legal problems later in life.

By not knowing who both parents are, the family as a whole would be reluctant to accept the child as one of their own. One reason that a family is hard to accept a child of a single parent household was that they worried about the social damages that the child could incur on the family's reputation. If the child becomes accepted into the family, he might still be ranked lower in social standing then the rest of the family, therefore creating a lower claim on property rights.

Contracts were the customary form of interfamily contact within Celtic societies, and they had to be authorized by the father. A child from a single parent household that is missing a father cannot form contracts because there is no one to validate it or offer up compensation if contract is broken. When a son is married he can make basic contracts without his father permission, but only once he has been married and even then a father can nullify the contract. If an unmarried son creates a contract without the father's authorization then the father has the right to invalidate it at any time. This makes it nearly impossible for the child of a single parent household to make contracts that could advance their social standing and or increase the amount of land that they own. The only way a fatherless person can make a contract is if another male relative steps in and authorizes the contract, which is rare, but found commonly among Celtic heroes. (Charles-Edward, 38) Contracting is important in any society because it is one way that person can advance themselves in life or at the very least support their existence.

Another way to advance materially in society is through inheritance. A person from a single parent household has major problems when it comes to inheriting. Children from single parent household lack the right of inheritance if the father is unknown. A mother could not pass on inheritance nor could she receive inheritance unless she is the last surviving member of the family line. Girls do not inherit because they are often married outside the family's range of influence. The father is the only one who could give out inheritance, which could be dispersed by either favoritism or split evenly among the sons. The reason that the father controls the distribution of his life's wealth is because he can insure that the wealth does not leave the family. (Patterson, 210 and Charles-Edward, 63) A child without a father lacks any right to inheritance giving them a

slimmer chance to rise above their social standing and increase income. The lack of a clear cut status, inability to create contracts and the lack of inheritance are all problems facing a child of a single parent household within Celtic society. These problems do not seem to be faced by a hero of single parent households found in Celtic literature.

The most famous example of a Celtic hero from a single parent household is Cú Chulainn. Cú Chulainn does not really experience any of the negative connotations attached to only knowing who his mother is. Nevertheless, he has to substitute trickery and deception for more customary forms of behavior. Cú Chulainn goes to the king of Ulster, Conchobar, to assume arms. Conchobar asks who is allowing him to assume arms and Cú Chulainn responds that the druid Cathbad had given his permission. Cathbad as a druid would have the social standing necessary to stand in as Cú Chulainn's father in this instance. The king after giving the arms to Cú Chulainn finds out that Cathbad did not give his permission, which causes both Conchobar and Cathbad anger. (Cross, 143) This is the only real problem that Cú Chulainn faces for being from a single parent household; he had no one to vouch for him to become a warrior. From this point on his feats win the hearts of the people of Ulster, and his feats combined with the Ulstermen's love for Cú Chulainn help to support him.

As has been demonstrated, Celtic literature suggests that the effects of being from a single parent household are more positive connotation then real life warranted. This might explain why literature tries to correct the idea of hero from a single parent household by giving a vague often contradictory explanation for who the father was. Retellings of Cú Chulainn's life give him multiple fathers, the earliest of which was Conchobar, then Lug or Sétanta (Cross, 136 and Mackillop, 115). The fatherly figure may have been added to increase Cú Chulainn's social status. The stories that contain Conchobar as Cú Chulainn's father, tell that Cú Chulainn was born of an incestuous relationship, but at the same time it makes him a prince. Conchobar may have later been replaced by Sétanta by the monks who tried to clean up the impurities they found in Celtic literature. Lug, was probably put in to make Cú Chulainn appear more god like. Even when his father mentioned, the father plays no part in the life of Cú Chulainn.

Two commons reasons for the absent father are that he is either a deity or a foreigner. The deity father figure is found in the legends surrounding Conaire and Cú Chulainn. When a deity appears to women, he will often come in the guise of a mortal or in the form of another creature as in the case of the Conaire's father coming in the guise of a bird (Cross 96). A deity rarely announces himself as such to the woman he impregnates but in one telling of the birth of Cú Chulainn, Lug comes to Cú Chulainn's mother and says he has impregnated her (Ó hÓgáin, 138).

If the father was a foreigner, then the relationship is rarely accepted by the family and the foreigner returns to his homeland. Bres, the anti-hero of the "Second Battle of Magh Tuired," has a mother of the Tuatha De Danann, or elves, and a father from the Fomor, a race of giants. Bres is raised by his mother's people in Ireland and does not meet his father until later in life. (Cross, 29) In another context, Cú Chulainn had a relationship in a foreign land with the warrior Aife; they produced a son named Connla. Cú Chulainn gave Aife a ring before he left with instructions to give it to their child and send him on a quest to find Cú Chulainn. Connla was raised far away from Ireland. He was not told who his father was until the day Aife gave him the ring and sent him in search of his father, who he does not know is Cú Chulainn. The foreign father giving a

gift to the mother before the child is born can occasionally be found. The gift acts as a way for the father to recognize the child later.

The heroes of Celtic literature do not always come from a single parent household; they may also come from a nuclear family. Celtic heroes like Conchobar and Conall both come from a family where both parents are known. The heroes that come from a nuclear family usually have parents with high social standing or a parent with a supernatural background. In the case of Conchobar his mother Nessa is a princess and his father Cathbad the druid (Ó hÓgáin , 110). Both of Conchobar's parents give him an attachment to both the real and supernatural world, already preparing him for the life of a hero. Conall was born to Fionnchoamh, a daughter of Cathbad, and to Amhairghin mac Eight Salaigh, a poet (Ó hÓgáin, 99). In Conall's case he is attached to both royalty and the supernatural world through his mother's family and by his father being a poet it gives his family some renown within the Celtic world. The Celts highly favored the poets and druids because of the rich culture knowledge that they have memorized and stored in their minds. A hero's childhood does not end here; a good portion of their young life is spent in fosterage.

The Artificial Family

Fosterage is the practice of having one family's children raised by another family. While found among other peoples, it was normal and widespread in Celtic societies. This is one of the many connections between reality and literature; fosterage of the hero is commonplace in Celtic literature. In Celtic society fosterage began at the age of 7, and ended at the age of 14 for girls and the age of 17 for boys, these are the ages when children are now considered adults and can start their own family. In fosterage children learned the valuable skills that are needed in the real world to sustain themselves. (Mackillop, 241) If a hero spends their childhood in fosterage, then the foster family would have the biggest impact on the hero's development.

Fosterage was a highly regulated practice and the literary versions were mirror images of the reality as found in the historical and legal materials. Fosterage began with an agreement between the biological parents and the foster parents. The foster family was usually related in some way to the mother (Patterson, 317). There were two types of fosterage: one with payment and one without payment. Fosterage without payment would include circumstances when the would-be foster family volunteers to take the child. If the fosterage were supported by a payment then the biological parents paid a price that was set at one honor price below the biological father's honor price grade. The exception was when girls were fostered; the price was set a little higher because they do not have enough control later in life to help support their foster parents. (Patterson, 190) Boys were expected to support their foster parents when they reached maturity. The only way the biological parent could get back the money from fosterage is if their child was sent back for no reason or if the child was abused by the foster parents. The standard of living and education level for the child in fosterage was based on the biological father's status. (Patterson, 190) During fosterage the actions of the children were the responsibility of the foster parents (Patterson, 191).

Fosterage was found everywhere, but especially among the nobility because they would have the money required to pay more then one fosterage family. In "The Destruction of Dá Derga's Hostel," Conaire's mother required that he be raised by three

foster families (Cross, 97). Multiple fosterage insured that the hero was well rounded, that the hero acquired the abilities needed to become a warrior and to also have some of scholarly aspects. Another benefit of having multiple fosterage families is the strength of the multiple alliances that it creates. (Charles-Edward, 79) The benefit of having multiple foster families was that the training and education would not be limited to a single style and would give the child a more broadly based education. Cú Chulainn is said to have been fostered by three individuals: Fergus, Amergin and Conchobar. Cú Chulainn's three foster fathers each specialized in a different area, Fergus was a great warrior, Amergin was a great poet, and Conchobar made him "a match for any chariot-chief" and gained valuable practice for dealing with nobility. (Cross, 159)

The relationship created by fosterage is very important and can often continue past the ending of fosterage. These alliances created a support system for the child or hero to call on upon in their time of need. When the child reaches the age of 17, the formal contract between the foster family and the biological family comes to an end. Whereas the relation that developed between the foster family and the child will often continue past the legal end of fosterage. The most affection can be found between the foster parents and the child due to the fact that the child spends most of life growing up with the foster family. A child in fosterage spends life away from their parents making the bond to them weaker then that of the relationship with the foster family. (Charles-Edward, 80) The heroes of Celtic literature are often aided by their foster fathers in moments of need. For example, when Diarmuid is running from Finn, Diarmuid gains valuable help from his foster father Angus Óg (Cross, 380). The relationship with the foster child and the children of the foster family was often strong too. This situation would only work if the child of the foster family is younger than the foster child. (Charles-Edward, 81) For example, Cú Chulainn and his foster brother Ferdiad refuse to fight one another in battle (Cross, 290).

The Moment of Change

In the hero's life there is a moment of change that announces the fully formed hero. At this moment it becomes clear to everyone that a hero is among them. The change for Cú Chulainn occurred the day he assumed arms. The druid Cathbad prophesized that whoever took arms for the first time on that day "would top the fame of all other Erin's men... (Cross, 143)." After this Cú Chulainn was on the path to becoming a great hero. For Finn the change occurred when he was cooking the Salmon of Knowledge and burned his finger. Finn became known thereafter as the man who knows everything. Whenever Finn does not understand something he places his thumb in his mouth. His extraordinary knowledge helps him become the leader of a travelling band of warriors. (Cross, 365)

The aftermath of the "moment of change" was striking. Ceremonies and rituals differentiated the hero from ordinary men. Feasting was an important aspect of Celtic society in literature as well as reality. This public display involved everyone in the community, who came together to celebrate a significant occasion. Feasting ceremonies ranged from one night to several nights and usually occurred in a special place such as fortress or banqueting hall. The layout of the feasting ceremony was organized around the king or the most prominent leader. Proximity to the king indicated rank and social status. A druid sat closer to the king then a cow-herder. Here is exhibited the higher quality of

life led by the hero. Heroes are given a seat of honor near the king at feasting ceremonies and "The Destruction of Da Derga's Hostel" mentions "the Champion's high seat of the house facing the king… (Cross, 111)." The hero's deeds and adventures are recounted so that everyone can be entertained with the exploits of the champion.

An important aspect of feasting was the "Champion's Portion" of meat. This piece of meat was the choicest and best piece of meat out of all the meat served and it went to the bravest person present, in most cases it went to a hero. The most famous individual ate the portion, as public acknowledgment of his prowess. More than one hero at the feast leads to conflict. In the instance of "Bricriu's Feast" three heroes--Cú Chulainn, Conall, and Loegaire—all compete for the Champion's portion of meat through tales and tests of feats. (Cross, 254)

Feasting is not the only medium that shows the higher quality of the heroic life. Not only do they receive preferential treatment, such as at a feast, but the hero is never mentioned to have an income, yet he somehow is able to survive. A hero's every need from repairing and finding new weapons, to their food, all of which was somehow supplied. One suggestion on this problem comes from hospitality. In Celtic society it was customary to take in weary travelers and to offer up food and lodging for a night. This custom was so widely practiced that storytellers would not have found the need to include it in their recitations. This omission might explain how the hero survived. The custom of taking care of travelers helps point to the idea that heroes were taken care of by their countrymen. Also, because the heroes protect the country from dangerous men and animals, their countrymen might have found the need to come for the heroes.

The Hero in Love

Everyone experiences love together with the trials and tribulations that accompany it, and a hero is no different. Although a hero for the most part spent life alone, there is a little romance involved. Sometimes the hero begins their quest for a mate at insistence of others. Cú Chulainn began his search when the Ulstermen forced him. They did this for two reasons: to protect their wives and daughters from Cú Chulainn and to provide a son to continue on his heroic legacy. Once Cú Chulainn decided to look for a mate, the search covered all Erin for an appropriate mate. (Cross, 151) The mate for a hero cannot just be any woman; she must be of the right pedigree. In the search for Finn's new wife the woman needed to be the "fairest of feature and form and speech (Cross, 371)." This "perfect" woman is considered to be blessed by God or the gods. Once a potential mate has been found, then it was up to the hero to woo her.

The wooing of a potential mate was completely up to the hero, it was his duty to win the love of his choice and convince the female that he was the best possible suitor. A hero will often recount their most heroic and dangerous adventures that they have experienced and who their foster parent were, all of which was the Celtic hero's form of flirtation. The woman that the hero is trying to woo would recount how great and honorable she was and would also recount the strengths of her many guards. The courtship and wooing of a mate is not easy for the hero, as in the case of Cú Chulainn. Cú Chulainn has to complete a mission set forth by Emer, the woman he is wooing, but also must complete a mission that Emer's father has set forth (Cross, 160-162). Even after Cú Chulainn has completed the mission set forth by Emer's father, he waited outside the stronghold for a year until an opportunity presented itself so that he could

complete the mission that Emer set forth (Cross, 169). Once the mission has been completed a hero can finally take his wife and marry her. Strangely there appears to be little mention of the marriage ceremony, but this could have to do with the fact that nothing heroic was accomplished in the marriage ceremony therefore it does not need to be retold.

The last important aspect to a hero's life is the presence of the supernatural in their lives. Every hero had their life affected by the supernatural at some point whether it was a god or a member of the Otherworld. The hero's life from birth to death was affected in some way by the supernatural. For many heroes the magical presence begins at birth, like in the case of Conaire's birth which was a creation of a supernatural being and a mortal mother. In the middle of Finn's childhood, he consumed the magical Salmon of Knowledge which gave him unlimited knowledge. Cú Chulainn experiences magical intervention of when his memory of Fann, a fairy woman, is wiped clean (Cross, 197-198).   The effect of magic on a hero's life can be both beneficial and detrimental. The magical effect on Cú Chulainn's life with him falling in love Fann, was detrimental to him because he laid there wasting away because the love had taken over every aspect of his life (Cross, 187). A positive magical effect on a hero's life would be in Diarmuid's flight from the wrath of Finn, he foster father Angus Óg used his magic to help protect both Grainne and Diarmuid.

Death, like the rest of the hero's life, is rarely normal. Often a hero's death comes as no surprise because there was some foresight. The day that Cú Chulainn assumed arms the prophecy not only said that he would be great but would also his life would be brief (Cross, 143). Taboos play heavily in the hero's life and their violation led to disaster. The idea that breaking a taboo leads to death reinforces how important taboos were in Celtic society. Taboos were taken very seriously in both Celtic society and its shows through the literature. In several cases a hero deliberately breaks a taboo even though they know it would lead to their deaths. When Conaire slowly broke all of his taboos, it slowly led him closer to his death one step at a time. Cú Chulainn was forced to break his taboo not to eat dog flesh and was killed in the next battle. The taboos not only helped guide the heroes in life but also helped to prevent their deaths.

Conclusions

Throughout the life of a hero they live by another set of rules, a hero is not exactly human but they are not a supernatural being.   The life of a hero from conception to death slightly differs from the life of the average person. Heroes live life on a pathway that divided the world of humanity and the world of the supernatural. On this pathway the hero experiences a mixture of both worlds and this is what sets a hero apart.

As mentioned earlier, the literature never mentioned a marriage ceremony for Cú Chulainn and Emer there could be many reason for this. One reason that a marriage ceremony was not brought into the literature could be that one cannot marry a hero. If a hero truly walks the pathway between humanity and the supernatural then a marriage in the sense that we know it as, a relationship between two individuals, is impossible because the hero lives in a world all their own. The average rules and regulations that govern humanity do not apply to the hero. Within the unusual marriage of Cú Chualainn and Emer, she acts more of a guider then a wife. When Cú Chulainn falls in love with Fann, he develops a wasting sickness, Emer comes to him and yells at him for being so

weak and letting himself waste away when he should really be protecting Ulster. Emer never once yells at him for cheating on her, this could be because she knows that she cannot hold him to the rules of humanity.

Another example of how a hero differs from the average person is the day that Cú Chulainn assumed arms. On this day his supernatural strength becomes known, helping to prove that he is not quite human. Cú Chulainn was unable to use weapons that are designed for the average person; he can only use the weapons that were meant for the King of Ulster, Conchobar. As one of the Kings of Ireland, Conchobar is believed to be closer to the divine beings then the average person because he is a visual representation of how good or bad the kingdom is doing. By assuming the arms of Conchobar, Cú Chulainn showed that he was also connected to the supernatural world.

Taboos help control the actions of the hero, but also help show that the hero does not exist fully in the world of humans. To the modern reader the taboos laid onto heroes see like commonsense, things that the average person know not to do. The hero seems to be lacking common sense, from the beginning heroes are rebellious and do not follow any of the rules. The taboos may act as a way to try and impose some of the commonsense ideas that the average person knows. As seen earlier these taboos often do not succeed in helping the hero prevent their death, the commonsense does not fully seep into the mind of the hero.

All throughout this exploration of the Celtic hero one has been presented with information from the literature that provides a brief glimpse into the world of Celtic Ireland. From the birth of a hero through the change and until death the experiences of hero set them apart from average human, but at the same time their experiences when taken lightly provide a glimpse into Celtic Ireland. The family of a hero, fosterage and the life of a hero are very important to understand the world of the Celts and also because it shows what the standard of masculinity was for the Celts.

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Human Capital Stimulates Economic Well-Being: A Cross-Country Comparative Study

Penelope K. Chambers, McNair Scholar, The Pennsylvania State University

Faculty Research Adviser: Dr. David Shapiro
Professor of Economics & Co-Director of Undergraduate Studies
Department of Economics
College of Liberal Arts
The Pennsylvania State University

ABSTRACT

With the advent of the knowledge economy comes the increased importance of education. In our global economy, there is more and more push to increase educational attainment so youth can readily compete against their global counterparts. As the significance of education in America has become not only a pertinent, but also pressing issue, there is a widening of skill differentials in the U.S. within the labor force that is making Americans and everyone else evaluate their education systems. The observed increase in years of education -- not only in the U.S. but in other countries as well -- is related to not only human capital, which is the skills the labor force has, but also to economic growth models. The more advanced skills the labor force has the more productive it can be; thus driving economic growth for a country. Measuring economic growth can be done using an exogenous growth model such as Solow's growth model. This paper examines data from numerous countries over a period of 23 years, and finds that human capital is a strong contributing factor to economic well-being and growth.

INTRODUCTION

Does the amount of education people of a country obtain help the country become more productive? Does the difference in educational attainment in countries explain the income disparities across countries in the world? With the advent of the knowledge economy comes the increased importance of gaining an education. In our global economy, there is more and more push to increase the quality and quantity of education so youth can readily compete against their global counterparts.

This research will explore the possible causes of income differences across countries within the scope of factor accumulation. There are several subproblems considered in this study. The first subproblem is to determine whether expected factors of production contribute to the income differences across countries. The second subproblem is to conclude that human capital components play a role in income differences. The third subproblem is to develop a benchmark where GDP per capita divides the sample into low income countries and high income countries. After developing benchmarks, the research will compare these samples to see how factors of production such as physical capital and population growth affect income as between low income and high income countries. Then, the research looks to see if these samples'

incomes are affected by human capital components. As there are several problems posed in this study, similarly there are several hypotheses used to predict answers.

The first hypothesis is that expected factors (from the Solow growth model) such as population growth and investment contribute to income differences across countries. The second hypothesis is that human capital components contribute to income differences. The third hypothesis is that there is a difference between low and high income countries in the effects of both population growth and investment as well as human capital components. Although this study focuses on human capital and economic well-being, there are several limitations that had to be considered throughout the study.

The study will not attempt to measure human capital through labor statistics. The measure of income will be GDP per capita, and in the data analysis the dependent variable will be the natural logarithm of GDP per capita. The study will be limited to a 23 year period sampling 124 countries from Africa, Asia, North America, Latin America and the Caribbean, Oceania, and Europe. The human capital variables will only be limited to the gross enrollment ratios for students enrolled in primary, secondary, and tertiary levels and will not consider graduation rates for these students. To further understand the significance of education variables in the model, there needs to be knowledge of human capital and economic growth. Human capital is the skills and knowledge people acquire that makes them more productive. Economic growth is measured as changes in output a country produces from one year to the next; essentially, economic growth is the change in GDP.

Assumptions include that data from the sources are accurate, the sample is representative of all countries, and the benchmark developed is an accurate indicator of what divides high income countries and low income countries.

As the significance of education in America has become not only a pertinent, but also a pressing issue, there is a widening of skill differentials in earnings in the U.S. within the labor force that is making Americans and everyone else evaluate their education systems. This increase in the importance of educational attainment is not related to the basic Solow growth model, but it is still an important factor influencing the level of GDP for a country. As the Solow growth model is used to measure income differences across countries by using factors such as investment and population growth, the study by Mankiw et al. (1992) adds a human capital component to the Solow growth model. Through a cross-country comparative study, my research will explore if human capital is a contributing factor to economic well-being and growth.

The organization of the rest of this paper is as follows. The next section will provide an overview of selected studies in this field and why they are significant to the present study. Then, the model and methodology will be described in the subsequent section where variables, countries, and criteria for selecting countries are listed as well as the formal methodology employed in the study. This is followed by a results and discussion section covering the findings and their interpretation. Finally, the paper closes with the conclusion and discussion of avenues of future research.

18

BACKGROUND

In the 1950's Robert Solow began analyzing and developing a model to explain economic growth. Using the production function which expresses a relationship between capital per worker and output per worker, Solow developed the Solow growth model to extend analysis to the factor accumulation related to physical capital such as investment and depreciation. The capital stock which is the entire physical capital in an economy is broken up into these two components: investment and depreciation. The Solow growth model is the change in capital stock, which is the difference between investment and depreciation, or:

$$\Delta k = \gamma f(k) - \delta k$$

where, Δk is change in capital stock, $\gamma f(k)$ is investment, and δk is depreciation. In addition to these variables, there is also the steady state which looks at how output per worker can be affected by the investment rate of a country, the Solow growth model uses investment rates and population growth rates. Generally, there is a negative relationship between population growth and output per worker, and a positive relationship between the rate of investment in physical capital and output per worker.

The Solow growth model only involves a physical capital component to economic growth. "A Contribution to the Empirics of Economic Growth" (Mankiw et al., 1992) extended the Solow growth model to human capital accumulation. The study showed that countries converge at their Solow steady state as the model predicts. This study will use components from both the Solow growth model and concepts from the Mankiw et al. (1992) paper. This will be further discussed in the next section: Methdology.

METHODOLOGY

As this study explores the effect of human capital on economic well-being, I used linear regressions for my study to see the relationship between factors that affect economic well-being, first using population growth and the investment rate and then adding human capital components. Initially I estimated regressions for an entire sample using data for GDP per capita from two different sources. As it is difficult to provide accurate data on GDP per capita for developing countries, using two sources allows the researcher to consider the robustness or consistency of the results. Independent variables include the rate of population growth, investment rate (inv./GDP), and the gross enrollment rates for primary, secondary, and tertiary education. Since this is a cross-country comparative study, I selected 124 countries from the UN-specified geographic divisions of the world: Europe, Oceania, Northern America, Latin America and the Caribbean, Asia, and Africa. The criteria for selecting the countries was the availability of information and if it was a developing country or developed country. This study used a time series approach, using data from 1980 to 2003. Two regressions were estimated in each case: a short version and a long version. The short version consists of log GDP per capita as the dependent variable and the gross investment rate and rate of population growth as independent variables. This is the basic Solow growth model. The long version consists of the variables in the short version as well as gross enrollment rates for

primary, secondary, and tertiary levels. The results of the regressions are discussed in the following section: the results section.

RESULTS

Several regressions were used to demonstrate the relationship between level of GDP per capita and human capital. The first set of regressions dealt with the entire sample of countries. One regression used World Bank data and the other regression used data from the Penn World Tables. Table 1 shows means for the variables in these regressions.

Table 1. Variables, Means and Standard Deviations
World Bank and Penn World Tables Data

Variable	World Bank		Penn World Tables	
	Mean	Std. Dev.	Mean	Std. Dev.
GDP/capita	6780	7025	6739	6505
log GDP/capita	8.1	1.3	8.2	1.2
Gross Investment Rate	14.5	9.6	14.3	9.7
Population Growth Rate	1.7	1.2	1.8	1.2
Primary Gross Enrollment Rate	95.2	23.0	95.2	23.3
Secondary Gross Enrollment Rate	58.3	34.6	57.7	34.4
Tertiary Gross Enrollment Rate	17.4	17.1	17.0	17.0

Sample Sizes: World Bank Data: 1352

Penn World Tables Data: 1359

Since several developing countries do not record economic data as frequently as developed countries and there are nonmarket (subsistence) production transactions occurring on a daily basis that are not recorded, this study used data from two sources in order to get an idea of the range of GDP per capita for these developing countries and to assess the consistency of results across two different sets of data. Table 1 shows that the means for the levels of GDP per capita and log GDP per capita from each source are comparable to each other. There is slightly more variance among the World Bank data for these two variables as compared to the Penn World Tables data. The gross investment for both sources is 14+% on average with the gross investment rate for the World Bank data at 14.5%. There is more variance in the Penn World Tables data than in the World Bank data for the gross investment rate. The means for primary, secondary, and tertiary gross enrollment rates are comparable to each other; the standard deviations for each source are similar.

Results of the regressions for the entire sample are found in Table 2. These results support the theory that investment has an impact on GDP/capita. The coefficients for the gross investment rate imply that a one-unit (i.e., one percentage-point) increase in the gross investment rate is associated with GDP per capita that is higher by 5-6%, holding population growth constant. In the short version of the model, there is a substantial impact of investment on GDP/capita. Log GDP per capita is negatively and significantly related to population growth. In the short version of the model, R^2 demonstrates that gross investment and population growth rates account for nearly 60% of the variation in the level of log GDP per capita. The short version of the model using data from the World Bank and the Penn World Tables gives different measures of the same equation. The results for the coefficients for both equations are significant at the 1% level. Even though both equations have a positive relationship between log GDP per capita and gross investment rates, there is a slightly larger impact of investment in the World Bank sample than in the Penn World Tables sample. These results demonstrate that the Solow growth model is an important model that explains a good deal of the variation in income per capita across countries.

Table 2. Determinants of log GDP/capita
Dependent variable: log GDP/capita

Variable	World Bank		Penn World Tables	
	Coefficient	Coefficient	Coefficient	Coefficient
Gross Investment Rate	.062**	0.021**	0.053**	0.017**
Population Growth Rate	-0.558**	-0.012	-0.490**	-0.061**
Primary Gross Enrollment Rate	-	0.005**	-	0.002**
Secondary Gross Enrollment Rate	-	0.024**	-	0.021**
Tertiary Gross Enrollment Rate	-	0.014**	-	0.012**
Intercept	8.179**	5.752**	8.343**	6.496**
F-Ratio	925.8**	1174.3**	917.6**	1129.2**
R -squared	0.579	0.814	0.575	0.807
Adj. R-squared	0.578	0.813	0.575	0.806

Sample Sizes: World Bank Data: 1352
Penn World Tables Data: 1359

**=coeff. sig. at 1% level
*= coeff. sig at 5 % level
+=coeff. sig at 10% level

Emulating the procedure from the Mankiw et al.(1992) paper on economic growth and human capital, equations 2 and 4 in addition to the basic Solow growth model components have human capital components: the primary, secondary, and tertiary gross enrollment rates. With the exception of the population growth rate in equation 2, both

regressions of the long version have significant coefficients for all of the variables with positive coefficients for each of the enrollment rates. The anomaly in these regressions is the impact of the secondary gross enrollment rates is much larger than that of the tertiary gross enrollment rates. The population growth rate has an inverse relationship to GDP per capita. Once human capital variables are added to the population growth rate and the gross investment rate, all the variables account for 80% of the variation in level of log GDP per capita, an increase by more than 20 percentage points from the short version. The results show that there is a relationship between the level of log GDP per capita and the investment in education levels. Essentially this means that countries that invest more in education will tend to have a higher GDP per capita.

To delve deeper, the sample of countries was stratified into high income and low income countries. The criteria for stratifying the countries was borrowed from the World Bank, whose definition of income groups designates those that have GNP per capita below 935 as low income countries. This second set of regressions divided the sample of countries into low income and high income countries. Table 3 has the means and standard deviations for low income and high income countries.

Table 3. Variables, Means and Standard Deviations by Income Level

Variable	World Bank				Penn World Tables			
	High Income		Low Income		High Income		Low Income	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
GDP/capita	17079	4586	3099	2828	16506	3891	3416	2837
Log GDP/capita	9.7	0.2	7.5	1.1	9.7	0.2	7.8	0.9
Gross Investment Rate	22.8	7.6	11.5	8.5	22.8	7.8	11.4	8.5
Population Growth Rate	0.9	0.9	2.0	1.1	0.8	1.1	2.1	1.1
Primary Gross Enrollment Rate	101.6	8.7	93.0	25.9	100.5	7.9	93.5	26.3
Secondary Gross Enrollment Rate	97.9	16.6	44.1	27.7	97.8	16.7	44.0	27.4
Tertiary Gross Enrollment Rate	37.0	17.2	10.4	10.3	36.9	17.7	10.2	10.1
Sample Sizes:	356		996		345		1014	

World Bank and Penn World Tables Data

The means for GDP per capita in the high income countries are about 5 times larger than the means in the low income countries.   The coefficient of variation (standard deviation divided by the mean) indicates the degree of variability for a variable. These coefficients are shown in Table 4.

Table 4. Coefficient of Variation by Income Level
World Bank and Penn World Tables Data

Variable	WB Coefficient of Variation	WB Coefficient of Variation	PWT Coefficient of Variation	PWT Coefficient of Variation
	High Income	Low Income	High Income	Low Income
GDP/capita	0.27	0.91	0.24	0.83
Log GDP/capita	0.02	0.15	0.02	0.12
Gross Investment Rate	0.33	0.74	0.34	0.75
Population Growth Rate	1.00	0.55	1.38	0.52
Primary Gross Enrollment Rate	0.09	0.28	0.08	0.28
Secondary Gross Enrollment Rate	0.17	0.63	0.17	0.62
Tertiary Gross Enrollment Rate	0.46	0.99	0.48	0.99

Except for the population growth rate, there is more variability in the low income country sample than in the high income country sample. The results from the regressions for the stratified sample are shown in Table 5.

Table 5. Determinants of log GDP/capita by Income Level
Dependent variable: log GDP/capita

Variable	World Bank				Penn World Tables			
	High Income		Low Income		High Income		Low Income	
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Gross Investment Rate	0.011**	0.010**	0.041**	0.013**	0.010**	0.009**	0.034**	0.009**
Population Growth Rate	0.022^{+}	0.059**	-0.509**	-0.009	0.004	0.026**	-0.464**	-0.022
Primary Gross Enrollment Rate	-	-0.006**	-	0.006**	-	-0.009**	-	0.004**
Secondary Gross Enrollment Rate	-	0.004**	-	0.018**	-	0.003**	-	0.016**
Tertiary Gross Enrollment Rate	-	0.003**	-	0.030**	-	0.004**	-	0.029**
Intercept	9.446**	9.470**	8.106**	5.704**	9.443**	9.857**	8.327**	6.294**
F-Ratio	25.1**	38.5**	381.0**	509.1**	26.1**	34.4**	389.7**	514.3**
R -squared	0.125	0.355	0.434	0.720	0.132	0.337	0.435	0.718
Adj. R-squared	0.120	0.345	0.433	0.719	0.127	0.327	0.434	0.717
Sample Sizes:	356		996		345		1014	

**=coeff. sig. at 1 % level
*= coeff. sig at 5 % level
+ =coeff. sig at 10% level

Note: Creating a benchmark of $935 for gross domestic product per person, the binary variables indicate if a country is high income (or above $935) or low income (below $935). Simply, Organisation for Economic Co-operation and Development (OECD) countries comprise mostly of high income countries.

24

The high income regressions modeling the basic Solow growth model have significant coefficients except for the Penn World Tables' population growth rate. There is an anomaly for the population growth rate coefficient in the high income regression. There is a positive relationship between population growth rate and log GDP per capita. This is contrary to the expected results from the Solow growth model. The short version of the high income regressions only had the explanatory variables account for about 13% of the variation in the level of log GDP per capita.

The high income regression long versions of the model have significant coefficients for all of its variables. Although all of the coefficients are significant there are two anomalies in the results. The first is in both the WB and PWT data in which population growth is positively related to the level of GDP per capita. The second anomaly is the primary gross enrollment rate is negatively related to the level of GDP per capita. Primary gross enrollment rate should be positively related because primary school is when the students learn the basic skills to help them become productive in the workforce. The coefficients are comparable to each other, the gross investment rate and population growth rate are larger in the World Bank regression. The gross enrollment rates' coefficients are larger in the regression using the Penn World Table dataset. The power of the explanatory variables increases once the long version of the model is used: the R^2 increases to 34%.

The low income regression modeling the Solow growth model has significant coefficients with the expected signs. The longer version low income regression has significant coefficients for all of their variables except for the population growth rate. According to the World Bank data the variables have a larger impact on GDP per capita than the Penn World Table data; this is shown by the larger coefficients in the World Bank regression. The R^2 indicates that the model explains 72% of the variation in the level of GDP per capita in the low income country sample.

The high income and low income country samples have several differences. There is a larger impact of gross investment for low income countries than high income countries. Although this may be the case, there is a larger impact of the gross investment rate on the short form than on the long form. Also population growth rate has more of an impact for high income countries than low income countries, but this may not be a reliable result because the population growth rate coefficient for the high income country sample was an anomaly. Overall, the R^2 for the country samples are considerably higher for the low income countries than for the high income countries.

DISCUSSION

The study design in this research was based on contemporary literature from two economic tools: the Solow growth model and the Mankiw et al. model. The Solow growth model includes the rate of population growth and the gross investment rate with the log GDP per capita. As for the Mankiw et al. model, it adds to the Solow growth model and includes human capital variables. In this study, gross enrollment rates were used as the human capital variables.

The findings in the study illustrate that the there is a positive relationship between level of log GDP per capita and the tested variables: gross investment rate, rate of population growth, and gross enrollment rates. The relationship between the variables were significant, for the most part, in the stratified sample. Despite the anomalies found in the high income country, related to the population growth and primary gross enrollment rates, the gross investment rate and the other gross enrollment rates were significant. There were no anomalies found in the low income sample. As expected, the low income countries had a higher R^2 when the gross enrollment rates were added. Essentially there was a larger impact on the R^2 for these countries compared to their high income counterparts.

There are several educational implications of this research. First, this research shows that the gross investment rate is a crucial component in determination of the level of GDP per capita and overall economic well-being. With this in mind, this research can be used to help developing countries develop policies to further accelerate their human capital.

There are several avenues of future research. One of the limitations in this study was measuring human capital and economic growth directly. There was a very weak relationship between economic growth and human capital. A possible avenue of future research is to look more closely at economic growth when seeing the relationship between human capital, investment, and population growth. Another avenue of future research is comparing the results of the regressions for the short version and long version of the models by the regions. Lastly after researching more on education systems in other countries, recommend policies can be developed to accelerate human capital in low income countries.

SUMMARY AND CONCLUSIONS

In conclusion, all of the hypotheses of this study receive support from the data analysis. Through the different models, the researcher tested all of these hypotheses. Expected factors such as population growth and investment contribute to income differences across the countries. The human capital components also contribute to income differences across countries. Finally through the stratified income sample, there was a difference in both population growth and investment for low and high income components affecting these samples with different weights.

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Racial Disparities in the likelihood of high school dropouts

Danielle Forbes, McNair Scholar, The Pennsylvania State University Faculty

Research Advisor: Dr. Kevin Thomas
Assistant Professor of African American Studies, Sociology, and Demography
Department of African and African American Studies
College of Liberal Arts
The Pennsylvania State University

Abstract

Previous studies have shown that racial disparities exist for many social and economic indicators in the U.S. The three most common races that are affected are African Americans, Hispanics, and Caucasians. This study will show the impacts of race and family structure on the likelihood of high school dropouts. Race plays an important part in understanding the education and achievement gap. However, differences in the likelihood of students dropping out of school cause most people to assume that all races do not have an equal chance of achieving an education. This study hopes to also answer questions related to race and accessibility to resources. This study will further discuss how to get the tools and resources that are needed for all races, in order to help reduce the prevalence of a high school dropout.

Introduction

This study examines the racial disparities in the likelihood of high school dropout amongst teenagers in different groups of races such as African Americans, Caucasians, and Hispanics. It will also examine how differences in family structure affect dropouts. The statistical program, STATA will be used to check the number of students from each race that are not enrolled in school, for drop out rates. For family structure, the study will examine the relationship between single parent family homes and drop out rates amongst different races and how this compare to the corresponding relationship among children in two parent family households.

Objective

The study will attempt to show that high school students living in single parent households are at a disadvantage in terms of dropping out of high school compared to students in two parent households. This study expects to prove that single parent family homes are at a disadvantage in comparison to two parent family households. The study also tries to understand why people that are Caucasian seem to be more privileged than those that are Hispanic and African American with regard to their schooling outcomes. It will also try to understand why there is a gap between different races amongst high school drop out rates. The following questions are examined. What is the problem? What

has been said? Why is race important in understanding this situation? What has not been said that we are trying to find?

Literature Review

The history of excessive drop out rates by many high school students has been a problem in society. Dropping out of school has been caused by high retention rates, failing classes, not attending classes and low scholastic achievement "(Garnier, Jacobs, Stein , 1997)." Some problems associated with increased rates in high school drop outs are single parent families, divorce, unstable family environments and income "(Garnier, Jacobs, Stein , 1997)." Other reasons people drop out are due to social background, race/ethnicity, gender, socioeconomic status, family structure and inner-city residence, academic background, ability, test scores, grade-repeating histories, academically related behaviors as engagement with school, grades, course completion and failures, truancy and school disciplinary encounters "(Burkam, Lee, 2003)." Many researchers have pondered the significance of many students dropping out of school at an alarming rate. The dropout rates have influenced many students to not empower themselves but settle for less.

Other related factors that affect many youths today include many sociological factors as not liking school in general or the school they were attending, not getting along with teachers or students, having disciplinary problems such as being suspended or expelled, or not feeling safe in school, had a family to support, got pregnant or had a drug or alcohol problem "(Schwartz, 1998)." According to Schwartz (1998), students that live in cities are twice as likely to drop out of school than students that do not live in the city, while Hispanics are twice as likely to drop out of school than African Americans. Caucasians and Asians differ because they are least likely to drop out of school. Mostly students tend to drop out by the eighth grade.

Another factor that has a significant impact on students is the structure of their household (Parcell, Powell, 1997). Some students live in single parent homes while others live in a home where both parents are present. When it comes to single mothers, many do not have the support to work and to help their children (Powell, Parcell, 1997). According Powell and Parcell, one parent present in the household lowers a child's capability in graduating from high school (Powell, Parcell,1997). They also noted that single parent households do not provide the proper "social and economic resources" for the child in high school in which can "negatively affect a child's success" (Powell, Parcell,1997). Boys that grow up with two parents, have a better chance of receiving a job that pays well than boys that grow up with just women as the head of the household showing that boys with single parent mothers receive jobs of lower pay than what their own father had as a job (Powell, Parcel,1997).

According to Parcell and Powell, single parent households lack the resources to give their children a higher education which causes a student to drop out of school at an early age. Single parent households with a mother present that do not have male figures present tends to cause a daughter to have children early or get married early because they have no male role models in their lives. For a son to be raised by a single parent causes him to not have a male figure. When whites come from a household of two parents where one of their siblings is pregnant, the other siblings are more likely to drop out of high

school (Powell, Parcell, 1997). The women in the family become at risk for not finishing high school as compared to the sons in the family (Powell, Parcell, 1997).

According to the Census Bureau ten percent of black single parent mothers hold a bachelor's degree compared to seventeen percent of white single mothers (JBHE Foundation, 2003). Only eight percent of single black fathers have a bachelor's degree which is lower compared to white single fathers, twenty-three percent of whom hold a bachelor's degree (JBHE Foundation, 2003). Those statistics are alarming for single parent homes, which shows that white single parent fathers are three times more likely to hold a bachelor's degree compared to a black single father (JBHE Foundation, 2003).

Parental income also affects a child because parents that did not go far in their education, have difficult times getting their child to develop (Corcoran, 1995). Single parent households where the female is in charge and with people who are not white are more than likely to experience living in poverty because they do not have the correct skills to provide for their children which causes economic deprivation "(Corcoran, 1995)." Many parents cannot help their children achieve a good education because of unmeasured parental values, health conditions and their own abilities "(Corcoran, 1995)."

Living in poverty not only causes a decrease in a child's IQ but also causes a decrease in educational attainment (Corcoran, 1995). This causes the child as they get older to not want to produce good work in high school (Corcoran, 1995). Many students drop out of high school because they do not have the correct resources supporting them in which causes the low wage rates and many hours worked when they leave school (Lichter, 1997). However, not only living in poverty affects a child but also living on welfare. Many parents accumulate a self-defeating work attitude and poor work ethics that their child experiences and eventually develops because they model what they see from their parent "(Corcoran, 1995)." If a child always sees their parent being dependent on a check every month and not being motivated to work in order to survive, then the child is more than likely going to depend on welfare as they get older instead of wanting to be independent (Corcoran, 1995).

Data and Methods

In order to achieve the objectives of this study, the data used was from the 2000 U.S. census and the analysis uses a variety of analytical methods. In the data, Caucasians, Hispanics and African Americans were used. The individuals that were excluded individuals were from other races because there was not enough information provided. Students in the age group from age thirteen to age nineteen that dropped out of high school were examined. Students below the age of twelve were not studied because students that are under age thirteen are not in high school yet. The minimum age was thirteen to a maximum age of nineteen because most people tend to be out of high school at that age. Students that graduated from high school were not present in this study. The program, STATA, was used for data analysis. The variables that were used were race, school enrollment, sex whether male or female, age, parental income from single parent and two parent households, welfare, dropout, and educational attainment. The expected outcome will show that single parent households are at a disadvantage compared to two

parent households when it comes to students dropping out of high school and that the disadvantage of single parent households is greater for minorities.

The methods that were used were mixed methods. The quantitative part is from the program STATA. The program, STATA, helped to determine the statistics of drop out rates amongst Hispanics, Caucasians and African Americans. However, all other research is qualitative with me using various scholarly articles to prove my research.

Definition of Dropout

Students between the ages of 13 and 19 who are not currently enrolled in school but at the same time, have not yet graduated from high school.

Results

According to Table 1, "Characteristics of Teenagers", the percentage of males is significantly higher than females. For blacks, the percentages of children that are living in single parent family households or live in poverty, are very high and nearly three times the respective percentages for whites. The percentage of children that live with parents that are on welfare are disturbing with 26% of white children, 61% of black, and 39% of Hispanics children. The average age is approximately fifteen for all the races.

Table 1 "Characteristics of Teenagers"

	Blacks	Hispanics	Whites
Females	49	48	48
Males	51	52	52
Age (mean)	15.4	15.7	15.4
Live in Single Par. HH (%)	59.5	35.68	25.16
Parents in Poverty (%)	28.99	25.65	9.57
Parents on welfare (%)	61.23	38.91	26.4
Sample Size	32,666	16,353	171,549

Table 2, "The Effects of Dropouts Amongst Race" presents estimates of schooling dropout amongst Hispanics, Blacks and Whites children in all the teenage ages. The way this table is shown is comparing the numbers of blacks and Hispanics in comparison to whites. The astericks show that the differences in the percentages are significant. Three asterisks means the numbers are statistically significant at the $p<0.001$ level while only one asterick next to a number would mean that the significance is lower, at the $p<0.05$ level. Table 2 also shows that white children whose parents live on welfare have a higher rate of dropout than black children whose parents are on welfare, while Hispanics have a higher percentage of teenagers who have dropped out than blacks and whites. Across the board, females from all three racial groups appear to have the lower numbers in dropouts in comparison to males. For children with parents that live on welfare in the Hispanic community, the percentages are double the percentages of blacks and whites. For children

with parents that live in poverty, whites and blacks have similar dropout rates with black males having 10.84% and females 11.64% in comparison to whites with 13.94% for males and females 13.83%. Female percentages on the table are relatively lower in all areas from welfare, to single parent family to parents in poverty.

Table 2- The Effects of dropouts amongst race

|	Males			Females		
	blacks	Hispanics	whites	blacks	Hispanics	whites
Single Parent family	9.95***	28.02***	12.15	9.12**	17.34***	10.22
Parents on welfare	9.93***	27.37***	12.03	9.12**	16.78***	10.24
Parents in poverty	10.84***	20***	13.94	11.64***	16.98***	13.83
ALL	8.3***	20.03***	6.6	7.18***	14.34***	5.7

Table 3, " The Percentage of Students that dropped out" at age 15, there is a trend where Blacks, Whites and Hispanics start to drop out of school. At age 16, the percentage of Hispanics that drop out of school is 10.71% in comparison to whites and blacks which shows for Hispanics, the percentage of children dropping out at this age is nearly double that of the other races. At age 17, the Hispanics lead once again in percentages. At age 18, there tends to be a significant rise in percentages for all three races. At age 18, Blacks dropout at 28.1% with Hispanics at 48.33% and Whites at 18.64%. This gap shows that there must be a reason for these large numbers from age 16 to 18. At age 19, the numbers change in race with instead of blacks usually having the second highest dropout rates, the percentages show that at age 19, whites have the second highest drop out rates. The Hispanics lead once again with 80%, with whites second with 66% and blacks third with 61%. The graph that shows the percent of students that dropped out shows the difference in drop out rates at different ages.

Table3-The Percentage of Students that dropped out

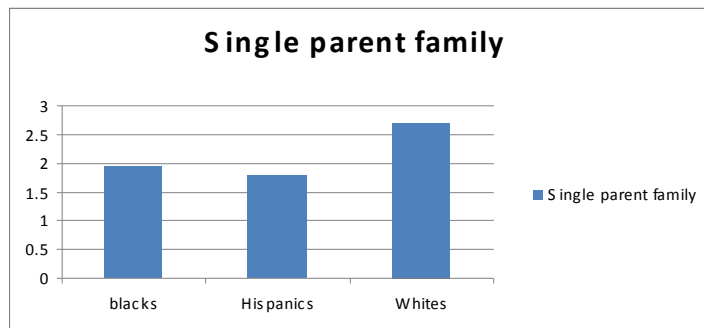| Age	Blacks	Hispanics	Whites
13	1.38	2.23	0.95
14	1.54	2.94	1.16
15	2.13	4.8	1.58
16	3.66	10.71	3.49
17	8.28	19.21	6.62
18	28.1	48.33	18.64
19	61.43	80.56	66.27

The odds of dropout within each race for teenagers in single parent families
Figure 1
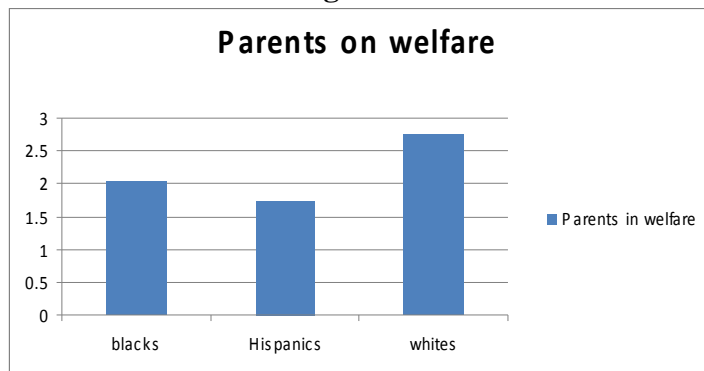
The odds of dropout within each race for teenagers whose parents are on welfare
Figure 2

Single parent family

The odds of dropout within each race for teenagers whose parents live in poverty
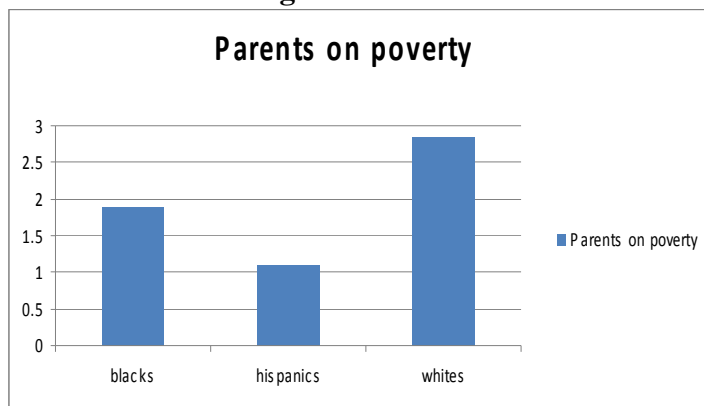**Figure 3**

Parents on poverty

Figure 1, Figure 2 and Figure 3 demonstrates the relationship between Blacks to Blacks, Hispanics to Hispanics and Whites to Whites. The three figures above also show that the odds of dropping out amongst children whose parents are on welfare, parents on poverty and single parent family households are higher in comparison to Blacks and Hispanics.

Conclusion

From the study of "Racial Disparities In the Likelihood of High School Dropouts", the conclusion is that Caucasians have the lowest dropout rates compared to African Americans and Hispanics. However, out of all three races, Hispanics have the highest drop out rates. This study has also shown that when Caucasians are affected by living in a single parent family household, having parents in poverty and parents on welfare when they have dropped out, it turns out they are more likely to drop out of school compared to African Americans. When it comes to single parent households in comparison to two parent family households, a single parent family household is at a disadvantage because they do not have enough resources to provide for a child in comparison to a two parent household. In order to diminish the number of students dropping out of school, there

should be more programs available to help students that are struggling in various subjects such as English and Math. There also needs to be more resources as after school tutoring, more funding for schools, as well as funding for books that appear as though they will fall apart.

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The Relation between Executive Functioning and Emotion Regulation in Young Children

Damaris Fuster, McNair Scholar, The Pennsylvania State University

Faculty Research Advisor: Dr. Pamela M. Cole
Professor of Psychology
Department of Psychology
College of Liberal Arts
The Pennsylvania State University

Graduate Assistant: Patricia Z. Tan, M.S.
Ph.D. Student
Child Clinical Psychology
The Pennsylvania State Universty

Abstract

To examine whether executive functioning (EF) in preschool age is a multidimensional set of processes and how these relate to aspects of children's emotion regulation (ER). Sample consisted of 119 48-month-old children. Relations between EF and specific indices of ER (e.g., latency to first bout of anger, duration of attempts at distraction) were examined. Support was found for the hypothesis that EF is a multidimensional rather than unitary construct. Also, accuracy on Less is More was related to the overall amount of anger children displayed, the frequency of anger bouts, and the average duration of periods of calm. Accuracy on DCCS task was related to the duration of the longest bout of distraction. Future directions for research in this area are included in the discussion.

Introduction

Over the last few decades there has been increasing interest in children's neurodevelopment. In particular, developmental scientists seek to understand the neurodevelopmental foundations of the maturation of social-emotional competence before children enter formal schooling (Dalton & Bergenn, 2007). One area within this broad topic that has received considerable recent interest is executive functioning. This subject has its origins in clinical research; adults with frontal lobe damage were found to have difficulties with self-regulation and emotional reactivity (Hughes & Graham, 2002). This early work helped to specify the role of the frontal lobes in executive processes that regulate behavior according to environmental demands and constraints (Zelazo & Muller, 2002). In recent years interest has extended to the development of executive functions (EF), particularly in preschool age children (Hughes & Graham, 2002), an age period during which the brain (particularly the frontal lobes) and EF are rapidly developing. It is believed that executive functioning may underlie the early development of self-regulation that is crucial for a child's healthy development, including the ability to regulate emotional reactions.

A challenge, however, for assessing executive functioning and its relation to self-regulation and emotional functioning in young children, is that it is unknown as to whether EF is a unitary or multidimensional construct (Garon, Bryson, & Smith, 2008). A number of scientists have tried to reveal the precise nature of executive functioning (Carlson, Davis, & Leach, 2005; Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996; Frye, Zelazo, & Palfai, 1995). One related challenge is the need to develop valid measures for assessing EF during periods when it is rapidly developing (Carlson, et al., 2005; Carlson, Moses, & Berton, 2002; Hughes & Graham, 2002).

Because one of the most important aspects of self-regulation is emotion regulation, in short the ability of a child to initiate effective efforts to adjust emotional reactions to social and situational constraints, a natural area of study is developmental relations between executive functioning and emotion regulation. The aim of the present study was to examine EF in children at age 48 months, an age that appears to be pivotal in the early development of EF (Zelazo, Carter, Reznick, & Frye, 1997; Gordon & Olson, 1998; Zelazo, Frye, & Rapus, 1996) and to examine whether measures of EF can predict aspects of child self-regulation of emotion. However, in order to understand the relation between executive function and emotion regulation we must first question what EF is and what it is composed of.

Construct of Executive Function

Executive function is defined as the ability to initiate goal-directed behaviors when one has to override established thoughts and responses that are more automatic in nature (Garon et al., 2008). This general definition however does not specify the process by which these behaviors are possible and whether it is best to conceptualize EF as a single process or as a multidimensional process that calls upon a number of cognitive functions. Some researchers have considered EF as a single unit (e.g., Duncan, Burgess, & Emslie, 1996), while most others (e.g., Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000; Baddeley, 1996; Diamond, 2001; 2002) have taken a multidimensional approach to EF. Diamond (2001, 2002) argues that there are two separate components to EF, working memory and inhibition. Working memory is the ability to hold a rule in mind during a period of delay. Inhibition is the ability to stop acting upon automatic urges. Because there is evidence to suggest that each has a different developmental path (Diamond, 2001; 2002) working memory and inhibition are said to be two different components. To support this theory, differences are shown in the developmental timing of various EF abilities (Carlson, 2005; Murray & Kochanska, 2002).

Set shifting is often cited as a third component (Lehto, Juujarvi, Kooistra, & Pulkkinen, 2003; Huizinga, Dolan, & van der Molen, 2006; Garon et al., 2008), although Diamond and colleagues regard set-shifting as the product of the combination of working memory and inhibition (e.g., Davidson, Amso, Anderson, & Diamond, 2006). Set shifting is the ability to switch between frames of references, such as rules. Neuroimaging research has confirmed that task-switching activates the neural system associated with EF (Brass, Derrfuss, Forstmann, & von Cramon, 2005) thus making it plausible that EF and set shifting are related. Still, there has also been evidence to suggest set shifting as a third component of EF (Miyake et al., 2000; Lehto et al., 2003). In a recent study by Lehto et al. (2003), performance on different EF tasks by 8-to 13-year-olds were found to cluster into three categories: working memory, inhibition and set shifting. Similarly, Garon and

colleagues (2008) listed working memory, inhibition, and set shifting as the three components that make up EF. This is similar to the multidimensional model we have followed.

The present study takes the view that EF is most likely multidimensional in nature and therefore selected tasks that, to differing degrees, assessed working memory, inhibition, and set shifting. Each component is arguably pertinent to emotion regulation. Children must keep social rules in mind even when they have urges to act in ways that violate those rules (for example, mother told me I have to wait to get the gift). They must also be able to inhibit action when they need to apply those rules (for example, avoiding opening, touching or even looking at a desired gift). Finally, set shifting should facilitate a child's ability to switch to a different frame of reference (e.g., distract oneself with other activities while tolerating a wait for a desired gift). Therefore, we tested whether our executive function tasks were correlated highly or, as we expect, related but not highly, and we then tested how each related to measures of emotion and regulatory strategy use.

There are a variety of tests of executive functioning for children and no clear evidence of which are the best. In the present study, three tasks were used: Peg Tapping (Luria, 1966), Dimensional Change Card Sort (DCCS) (Frye et al., 1995) and Less is More (Carlson et al., 2005). Each of these has been shown to tap certain components of EF (Carlson et al., 2005; Frye et al., 1995; Luria, 1966; Garon et al., 2008). For instance, Blair, Peters, and Granger (2004) used Peg Tapping as a measure of inhibitory control and cognitive set-shifting ability. In our study Peg Tapping was used as a measure of complex response inhibition that also calls upon working memory. In other words, in order to successfully complete the task the child must be able to hold a rule in mind and inhibit prepotent urges in order to respond correctly (i.e., NOT imitate the action of the experimenter). We also used the DCCS task, which according to Garon and colleagues (2008) assesses set shifting. Specifically, DCCS requires the ability to shift attention focus from a dominant sorting dimension (color) to a less dominant aspect (shape). The third task we selected was Less is More, which is classified as a test of complex response inhibition (Garon et al., 2008). Similar to the Peg Tapping task, it requires a child to hold a rule in mind (the monkey will take the plate of treats that I select) and inhibit prepotent response (to select the plate with more treats) in order to successfully complete the task.

Emotion regulation in preschoolers

Cognitive processes, such as the executive functions described, are believed to support the ability to self-regulate emotion (Kopp, 1982; 1989). Executive functions are known to develop slowly between infancy and early adulthood, although they develop rapidly in certain periods, including the preschool years (Carlson & Wang, 2007). The cognitive processes that are included in the term "executive function" are arguably the most important for the development of emotion regulation.

Emotion has been defined as preparation to create, maintain, or alter one's relation to one's environment when the situation is of significance to one's well-being (Saarni, Mumme, & Campos, 1998). Emotion regulation (ER) has been defined as the processes that are responsible for the monitoring, evaluating, and modifying of emotional reactions in the service of achieving goals for well-being (Thompson, 1994). Most often the terms refers to patterns of emotion regulation that lead to behavior that is socially

acceptable (Kopp & Neufeld, 2003). According to Eisenberg and colleagues (Eisenberg et al., 2007), emotion related regulation consist of processes that change one's emotional state, prevents or initiates emotional reactions, and modulate the behavioral expression of one's emotions. ER relies on intrinsic and extrinsic regulatory processes, including awareness of social norms and the ability to apply them to expressive behavior (Carlson & Wang, 2007). Children who efficiently execute emotional regulation are less likely to develop maladjusted behavior (Eisenberg et al., 2007).

In the first months of life, infant emotional expressions elicit social assistance from adults who then regulate the child's emotions through care giving and interaction with the infant (Eisenberg et al., 2007). But, when adult assistance is not available, infants have limited ways of reducing discomfort. When a baby encounters a novel situation the infant may try to look away in order to relieve discomfort. This is truly a case of "out of sight, out of mind." The infant looks away and distress is temporarily reduced (Stifter & Braungart, 1995). Infants engage in basic forms of ER such as gaze aversion, sucking, and proximity seeking (Buss & Goldsmith, 1998). Between ages 2 and 4 years, the need for external support declines somewhat, particularly in familiar problematic situations, and is increasingly replaced by socially acceptable strategies of self-regulation (Eisenberg et al., 2007). Between the ages of 2-5; cognitive, socio-cognitive, motor, and language development rapidly occurs (Kopp, 1989; Kopp & Neufeld, 2003). By preschool age children are capable of behaving in socially acceptable ways, even when an external entity is not there to monitor the child's behavior (Kopp, 1982). This rapid growth allows for more sophisticated and diverse forms of self-regulation to develop. (Eisenberg et al., 2007)

During the preschool years a child's ability to regulate emotions improves by way of monitoring the manner in which behavior is expressed (Carlson & Wang, 2007). By the age of 4, motor inhibition is established (Eisenberg et al., 2007). Regulating emotion involves the ability to engage in effortful control (EC), which is believed to be part of executive function. EC is defined as the capability to undergo executive attention, including the ability to inhibit an automatic behavior and to activate a secondary response, to plan, and to detect error (Rothbart & Bates, 2006). EC involves the inhibition of an action and the initiation of another, especially when the child prefers not to do so but must in order to adapt to social expectations or to achieve a goal (Eisenberg et al., 2007).

In the case of emotion regulation, an emotional reaction is a fairly automatic, well-established response to perceived challenges to an individual's well-being (Barrett & Campos, 1987). It is a reaction that is not consciously controlled in early childhood and that can lead to behavior that is socially undesirable, such as temper tantrums. In the course of early childhood, parents socialize children to control these automatic emotional responses (Saarni et al., 1998). For the child to behave in socially appropriate ways when emotionally aroused, inhibitory control must be practiced. Preschoolers who have difficulty are often identified as either having psychopathology or being at risk for it (Hughes & Graham, 2002). For example, when a child cannot have a toy that the child desires, the child must learn to inhibit angry demanding and aggressive action to get the toy. Executive processes may provide the means by which children can delay and reorient their behavior under circumstances that elicit automatic emotional responses such that they override the action tendency associated with the emotion and behave in socially

acceptable ways. According to Hughes and Ensor (2007), children's ability to understand internal states and interpersonal relations, rely on executive function. Studies have shown that as children age, their scores on EF tasks increase (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996; Kopp, 1989). A child's ability to regulate their actions also increases during this time (Kochanska et al., 1996; Kopp, 1989). If EF and self regulation are developing during the same time period they may be interrelated. For this reason, the present study tested the prediction that EF processes would relate to specific aspects of emotion expression and regulatory strategy use. Using anger eliciting tasks that were previously coded by others, the present study related variables derived from coded emotion regulation strategies and anger expressions and related these to children's accuracy on a set of tests of executive function.

Executive Function and Emotion Regulation

In sum, theory and evidence support the prediction that executive function processes and emotion regulation are related (Hoeskma, Oosterlaan, & Schipper, 2004; Kieras, Tobin, Graziano, & Rothbart, 2005), but the precise nature of the relation requires specification (Carlson & Wang, 2007). If a child's performance is lower in one domain (EF or ER) than performance in the other domain is likely to be low as well, supporting the idea that EF and ER may be related (Frye et al., 1995). There are three possible ways that executive function and emotion regulation might relate (Carlson & Wang, 2007):

1. EF➜ER: The first possibility is that general inhibitory processes are necessary for successful emotional regulation. In this model we would expect ER to rely on the development of inhibitory control and the growth of ER.

2. ER➜EF: The second possibility states that ER is required for the successful initiation of inhibitory control. Having more efficient coping skills (self-regulation) opens up cognitive resources for more effective problem solving.

3. **EF⬅➜ER**: The third possibility combines the previous two into an integrative model. Deliberate self-regulation of emotion is achieved via conscious cognitive processes. When the primary goal is to regulate emotion EF and ER are undistinguishable. When modulating emotion is secondary and it occurs in conjunction with another problem, EF is said to involve ER.

The role EF plays in social interactions is very important from early on in development (Carlson, Moses, & Breton, 2002). In terms of the relation to emotion regulation specifically, there is evidence from Balaraman's (2003) study that children with weak inhibitory control are involved in more negative exchanges with peers than children with well developed inhibitory control. However, the specifics on how they relate are unknown (Carlson & Wang, 2007), in part because there remains uncertainty as to the best ways to measure EF (Carlson & Moses, 2001) and ER (Cole, Martin, & Dennis, 2004). Our study focuses on several experimental tasks that have emerged to assess EF in preschool age children and observational procedures that capture the temporal dynamics of children's emotional responses and strategic behaviors to assess emotion regulation.

Because toddlers have not yet fully developed their ability to convey internal feelings verbally, observational methods have been commonly used to infer emotional

episodes (Zeman, Klimes-Dougan, Cassano, & Adrian, 2007). Facial expressions and body gestures relay crucial information about the emotion being felt internally (Zeman et al., 2007). Self-regulation, behavior regulation, and self-control have been used to describe behaviors that aid individuals dealing with stressful situations (Bridges & Grolnick, 1995). Such constructs have been indexed in various ways such as latency to behavior during waiting (Mischel, 1974). Mischel and colleagues (1974) examined several behaviors thought to be relevant in emotion regulations, specifically those that seem to influence delayed gratification.

In this study we used a task that requires a child to wait for an extended period (Vaughn, Kopp, & Krakow, 1984) to observe two specific strategies thought to regulate emotion; self distraction or shifting of attention (Derrberry & Rothbart, 1988; Fox, 1989) and support seeking. For this study self distraction ranged from looking away (Fox, 1989) to sustained use of a toy (Braungart & Stifter, 1991). Support seeking, one of the strategies used most frequently in situations requiring delay of gratification (Grolnick, Bridges, & Connell, 1996), was characterized by a child distracting the mother during the Wait task and asking her about the surprise on the table.

Gaze aversion as a strategy has been shown to reduce feelings of distress following a delay in gratification among infants (Buss & Goldsmith, 1998). Distraction with a toy has predicted decreased anger in toddlers (Calkins & Johnson, 1998; Grolnick et al., 1996). For our study support seeking was regarded as an unwanted strategy because distracting the mother would theoretically cause her to take long on her task and longer for the child to receive the surprise. In our study we predicted that if a child has higher EF skill they would be less likely to support seek and more likely to self distract in order to alleviate distress. If stress is alleviated there should be less and shorter periods (bouts) of anger and longer bouts of calm or neutral states.

Present Study

The focus of this project was to examine the relations between two constructs—executive function and emotion regulation in children 48 month of age. To do this, we related four purported measures of executive function with children's behavior during three tasks that challenged them emotionally. These tasks were designed to tap into EF in a multidimensional manner. This is to say that we believe EF is not a unitary construct but rather a construct composed of different components. Our EF tasks evaluated: working memory, inhibition, and set shifting. Measures such as: Less is More (Carlson, Davis, & Leach, 2005), Dimensional Change Card Sort (Frye et al., 1995), and Peg Tapping (Luria, 1966); were used to operationalize EF. More specifically, these tasks tested for response inhibition, set shifting, and working memory. Less Is More tapped into complex response inhibition. Complex response inhibition involves the ability to inhibit while being able to hold a rule in mind. Dimensional Change Card Sort was used as a test for set shifting in which the child was required to have the ability to shift mind sets. Finally, Peg Tapping was used to evaluate simple working memory and complex response inhibition. The Children were required to keep the rule of the task in mind while inhibiting automatic responses.

It is also challenging to assess emotion regulation (Cole et al., 2004). In early childhood, the most common method is to observe the young child during a laboratory task in which emotion is likely to be elicited. For example, anger or frustration is studied

by blocking children from getting or doing something they desire. In the present study, we used Wait Task (Vaughn, Kopp, & Krakow, 1984) to assess ER. The session was videotaped and later coded for the types of strategies used during the task by the child and the emotions being expressed. These tasks were used to answer the following questions:

1. Is executive function unitary or multidimensional?

2. Do specific components of EF relate to parts of ER?

Based on the available literature, we made the following hypotheses: 1. Executive function is made of multiple components, such that each test would be related to the other but would not be so highly related as to be redundant, as would be the case in a unitary model. 2. The more correct responses a child makes (accuracy) in EF tasks, the less often, less long, and less intense the child's anger will be during a frustration task, and the more often and longer the child will maintain a calm (neutral) demeanor. Moreover, if EF is multidimensional, then the complex response inhibition tasks (Peg Tapping and Less is More) will be more related to the emotion regulation indices than the DCCS. 3. The more correct responses on EF tasks the child makes, the more often the child will be able to use distraction as a strategy during a long boring wait and the less likely the child will rely on the less mature strategy of support-seeking. The DCCS, an index of set-shifting ability, should relate specifically to distraction. 4. Finally, the more correct responses on the DCCS a child makes, the more likely the child will be to use the most optimal regulatory strategy for the specific frustrating task, that is, focused distraction.

Method

Participants

For the larger project, families were recruited who met two criteria: (1) the family had a child who would be 18 months of age at the first (home) visit and (2) the annual household income had to be above the government-defined poverty threshold but at or below the national median income. Of the 128 families recruited, 3 were income-ineligible, and 5 missed two or more visits of the 8 possible visits (4 home and 4 lab visits over 30 months of the child's life). As a result, the sample that will be studied for the present study includes 119 children at the age of 48 months (63 males; 56 female). .

Procedures

For the larger study, children were observed and tested every six months from the age of 18 months to that of 48 months and then a year later at 5 years. For half of the visits, naturalistic home observations were conducted at four ages (18, 30, 36, and 42 month visits) and standardized laboratory tasks, assessing emotion regulation, emotion knowledge, cognitive and language functioning, and parent-child interaction were administered in a lab playroom setting (18, 24, 36, 48 months, and 5 years). The aim of the larger study was to understand the early development of emotion regulation, the child and parenting characteristics that predict its development, and the role of stress in interfering with its development. A variety of measures were used including; self-report questionnaires, interviews, and behavioral observations. The current study focuses only on laboratory data from the 48 month lab visit and tasks that assessed executive function and emotion regulation.

Each child was brought into the lab by one or both parents. Upon arrival, there was an introduction period used as time to allow the child to get used to the experimenter. The session was videotaped through a two-way mirror. The lab visit lasted approximately three hours. Among the procedures administered at the 48 month visit, there were three tasks that were used to assess EF processes: these tasks were: Peg Tapping, Dimensional Change Card Sort, and Less Is More.

Peg Tapping (Luria, 1966). This task was used as a measure of working memory and complex response inhibition. The child is seated across the table facing the experimenter. The Experimenter (E) first explained the rules to the child and made sure the child understood the basic steps. The test itself requires the child to tap twice when the E taps once, and to tap once when the E taps twice. Hence the child must remember the rule and inhibit the prepotent tendency to imitate the E. There were 16 items, randomly presented to the child. The number of correct responses was the variable used in analyses.

Dimensional Change Card Sort (Frye et al., 1995). The DCCS assesses set-shifting. For the DCCS the child was seated facing two card trays, across from the E. One tray had a card of a red rabbit while the other had a card with a blue boat printed on it. The child was told they were going to play a game with these cards. The first game was one dimension (e.g. color) for half the sample and the other dimension (e.g. shape) for the other half of the sample. The E showed the child two standard cards: a red triangle and a blue ship. For example the child was told, "We are going to play a game. This is the color game. The color game is different from the shape game. All the red ones go in this box, and all the blue ones go in that box. We don't put any red ones in that box. No way. We put all the red ones over here and only blue ones go over there. This is the color game." Then after two correct trials the game was switched to the other type of task (either the color or shape game). For each card the E stated the relevant rules for the game and asked the child where the card went. The E than showed the child five cards that were drawn at random. The limit for drawing the same card was twice. Once six trials were administered, the task switches to the game that the child initially started with. Six trials were administered per game regardless of how many they get right or wrong. The number of correct trials was the variable used in analyses.

Less Is More (Carlson et al., 2005). Less is More tests complex response inhibition. It was a task in which children were given two choices of which treat they would use during the task. They were allowed to eat the sample treats in order to aid them in their decision (e.g. jellybeans). Once the child made a decision the experimenter (E) recorded the choice and grabbed a large bag with the designated treat inside it. The experimenter adjusted the plates on the table, and placed a stuffed animal monkey on the right side of the child. The E began to explain the rules to the child. The E asked which amount the child preferred (a little or a lot of the selected treat). The child was told that the plate in which s/he selected was the plate the naughty monkey would receive. The task was repeated for a total of 8 trials, and then the monkey was transferred to the child's left side. Eight more trials were done with the same rules still in place. Throughout the task the child was reminded of who received the treats on the plate he chose (the monkey) and each child was given 16 trials total. The number of correct trials was the variable used in analyses.

In addition to the tests of executive functioning, standard laboratory tasks were use to assess children's emotion regulation. For this study a wait task (Vaughn et al., 1984) was used to assess emotion regulation and to elicit anger from children by blocking their goal of immediately getting a desired object.

Wait task. Before the task began, the mother of the child was brought into the room and asked to fill out a questionnaire. The E gave the child a broken toy and placed an attractively wrapped gift on a table in the middle of the room. As previously instructed, the mother told the child "This is a surprise for you but you must wait until I finish my work to open it." After eight minutes, the E returned and the mother allowed the child to open the surprise. The child was then allowed to play with the gift (magnetic marbles). The task was videotaped and later emotion expressions (e.g. angry and neutral) and regulating strategies (distraction and bids to mother, or support-seeking) were coded by independent coding teams.

All of the data analyzed in the present study was drawn from a previously collected data set that was part of a larger, longitudinal study at the Pennsylvania State University. The larger project, called the Development of Toddlers Study (DOTS; Cole, Crnic, Nelson, & Blair, 2000) was supported by the NIMH (RO1-MH 63188) and conducted with the approval of the Penn State University Office of Research Protections (Protocol 18993). The data were collected by graduate students and coded by undergraduate students. The present project involved the analyses of variables that those students generated.

Data Coding and Reduction

Child emotion expressions and regulatory strategies were coded by separate teams of coders. Coding was time synchronized so that each coder was making judgments in the same 15 second epochs. For each epoch, a coder on each team classified which emotions or strategic behaviors occurred.

Variables. Based on the coding, several variables could be generated. For example, for anger expressions, the variables were total number of epochs, number of bouts, average bout duration, maximum bout duration, and latency to first bout. Number of bouts was the number of epochs in which an emotion (i.e. anger) was continuously displayed. A "bout" was counted when the child was coded as (e.g. angry) during continuous epochs; a bout ended when there was an epoch in which the child was not angry. Average bout duration was calculated by adding up the lengths of all the bouts (i.e. anger) and dividing it by the number of bouts. Maximum bout duration was the length of the longest bout in which the emotion was felt (e.g. anger). Latency to first bout was the amount of time it took to initially express a certain emotion (e.g. anger). There were a total of 32 epochs.

Emotion Expressions. Expressions of anger and were coded based on facial, vocal, or postural cues. Neutrality was coded when no other emotion was being expressed. Expressions were coded if one or more cues were present. Anger facial cues included: furrowed brow, lips pressed, and a clenched jaw. Anger vocal cues included: harsh toned vocals conveying protest, loud, and deep pitch. Anger postural cues included: finger wagging or jabbing and fists placed on hips.

Regulatory Strategy Use. Once emotions were expressed regulating strategies were coded. Specifically, support seeking and distraction were coded. Support seeking

consisted of: asking mom for or about the demand item, bring the surprise to mom, and asking when mom would be done with the questionnaire. Distraction is defined by child-initiated attention shifting from a source of distress or the demand of a task. Coding for distraction included: attention shifting from the source, playing with the boring toy, attention absorbed (looking at something outside of the task intently), etc.

Summary of Hypotheses

In sum, we predict that EF is a multidimensional construct and that specific variables generated by EF tasks will predict a child's ability to delay and abbreviate anger in a frustrating task, a boring wait. The predictions are: 1. Executive function is made of multiple components, such that each test will be related to the other but will not be so highly related as to suggest a unitary construct. 2. The more correct responses a child makes (accuracy) in EF tasks, the less a child will express anger during a frustration task, and the more often and longer the child will maintain a calm (neutral) demeanor. Moreover, if EF is multidimensional, then the complex response inhibition tasks (Peg Tapping and Less is More) will be closer related to the emotion regulation indices than the DCCS. 3. The more accuracy on EF tasks, the more often the child will be able to use distraction as a strategy during a long boring wait and the less likely the child will rely on the less mature strategy of support-seeking. The DCCS, an index of set-shifting ability, should relate specifically to distraction. 4. Finally, the more correct responses on the DCCS a child makes, the more likely the child will be to use the most optimal regulatory strategy for the specific frustrating task, that is, focused distraction.

Results

Data Preparation

Upon inspection of the data, one child's data was removed due to the child's lack of cooperation during all three EF tasks. Another child's scores were adjusted due to experimenter error. The error occurred during the Less is More task in which the E administered the test incorrectly during the second phase of the test. Scores from the first part showed that the child received a perfect score and thus we gave the child the same score on the second part of the task. The E also committed an error also occurred during DCCS. The E only administered 4 trials when they were supposed to administer 6. The child received 3 out of 4 correct during the task, thus we altered the score to 5 correct. Statistical outcomes were not affected by the alterations. Pearson correlations, before and after the change showed that there was no change in how significantly the tasks related to each other. All correlations remained the same (see Table 1).

As is common, several variables were skewed. Logarithmic transformations were used to improve skewed data for these variables (see Table 1). These transformations improved the distributions such that parametric analyses could be conducted, as skew was reduced to acceptable limits for nearly all variables. This therefore reduces the risk of spurious results due to outlying values.

Executive Function Construct

One-tailed Pearson correlations were used to assess the relations among the accuracy scores (number of correct responses) for each of the three EF tasks. If EF is a unitary construct, a correlation close to 1.00 is expected. Results support the prediction

that EF is a multidimensional, rather than unitary, construct. As shown in Table 2, there were several significant relations among the EF scores, but the magnitude of the relations was quite modest (average $r = .24$). Moreover, the range (.11 to .31) indicates varying degrees of relatedness among the three EF tests. Peg Tapping number correct was significantly related to DCCS number correct, $r (107) = .31$, $p < .01$, and to Less is More number correct, $r (112) = .30$, $p < .01$. However, DCCS number correct was not significantly associated with Less is More ($r (112) = .11$, $p = .13$). The fact that all of the variables were not equally related and that even the significant relations were modest in magnitude suggests that EF is more accurately conceptualized as a multidimensional, and not unitary, construct. .

Relations among Executive Functioning and Aspects of Emotion Regulation
Emotional Expression

As predicted, some modest relations were found between EF and measures of child emotion. Specifically, the number of correct responses in Less Is More was inversely related to the number of bouts of anger, $r (112) = -.20$, $p < .05$, average bout length (duration) of anger, $r (112) = -.17$, $p < .05$, and maximum bout duration, $r (112) = -.18$, $p < .05$. That is, the more times the child remembered to point to the plate with *fewer* treats, the less angry the child appeared during the wait task.

Similarly, accuracy on Less Is More was modestly related to the child's neutral epochs, both the total number of neutral periods, $r (112) = .16$, $p < .05$ and their average bout length, $r (112) = .16$, $p < .05$. That is, the better the child's performance at this task, the more frequent and longer the child's periods of calm demeanor.

Contrary to expectation, accuracy on Peg Tapping and the DCCS was not related to anger variables. Furthermore, accuracy on these tasks was not related to any of the calm emotion variables (see Table 2).

Emotion Regulation Strategy Use

Though the number correct in Less Is More was related to the expression of anger it was not related to strategy use (see Table 3). Similarly, Less Is More was not related to the use of distraction (see Table 3).

However, accuracy on the Peg Tapping task was modestly related to strategy use. Specifically, the more accurate the child was on Peg Tapping, the longer the longest bout of support seeking during the wait, $r (106) = .18$, $p < .05$. Accuracy on the DCCS was also related to support seeking, but to a different measure of supporting seeking. That is, the more correct responses the child had on the DCCS, the longer into the task it was before the child first sought support from the mother, $r (107) = .21$, $p < .05$. Contrary to expectation, accuracy on DCCS was inversely related to maximum bout duration of distraction, $r (107) = -.19$, $p < .05$. That is, the more accurate a child was on the DCCS, the *shorter* the child's periods of self-distraction were.

Discussion

The questions that led to the present study were two: (1) is executive function a unitary or multidimensional process and (2) do aspects of executive function relate systematically to emotion regulation. Partial support was found for a multidimensional model and for relations between at least one purported measure of executive function and

children's anger. The discussion develops interpretations of the findings and addresses limitations and possible future research topics.

Executive Function: Unitary or Multidimensional?

As predicted, our results support Garon and colleagues' (2008) view of executive functioning as a multidimensional process. The fact that the different measures of executive functioning, drawn from the contemporary research literature on EF in early childhood, did not correlate suggests that they may tap different aspects of EF. Peg Tapping was moderately correlated with both Dimensional Change Card Sort and Less is More. Perhaps this is due to the nature of peg tapping. Peg tapping taps into: working memory, response inhibition and may tap into set shifting; all of which are part of either DCCS or Less is More. However, DCCS and Less is More are weakly associated and do not have a significant relation. Maybe the weak association is due to the difference in what each task tests for. Less Is More is a better measure of response inhibition, while DCCS is used to measure set shifting. Perhaps set shifting and response inhibition are two very different components of executive function. Because there was not a perfect correlation ($r = 1.00$, $p < .01$) among any of the tasks, interpretation of the correlations suggest that EF is not unitary.

Executive Function and Emotion Regulation Relations
Emotion Expression

Is accuracy of EF tasks related to the expression of emotion? According to our findings, accuracy on Less Is More is associated with the expression of emotion (see Table 3). More specifically, Less Is More was related to the expression of anger and the maintenance of neutrality. Less Is More was the only task that proved to be moderately correlated with the expression of emotion.

Perhaps Less Is More taps into "hot" EF processes, requiring children to inhibit strong affective reactions (Metcalfe & Mischel, 1999) Hot EF processes are different from cool EF processes in that hot EF processes involve affective motivation. If the child is emotionally invested (affectively motivated) in the task it is considered to tap into hot EF processes. Because Less Is More is a task that involves attainment of a physical object (treats) the child is more likely to be emotionally invested in this task than in the other EF tasks. Thus, Less Is More may measure children's ability to inhibit pre-potent actions that are not only automatic but also affectively motivated. Likewise, Wait task involves a tangible reward (the surprise) which may explain the child's emotional investment and expression within that task. In comparison, Peg Tapping does not involve a tangible reward (the treats) and thus may not require the "hot" EF processes that are involved in the Less Is More and Wait tasks. The DCCS task is considered a cool EF task (Hongwanishkul, Happaney, Lee, & Zelazo, 2005) because it is also does not involve appetite or emotional investment. This may explain why the emotion measures were not related to either of these tasks.

Another reason that Less is More was the only task that was related to the expression of emotion may be that Less is More is a better measure of complex response inhibition. Because Less is More was inversely related to indices of expression of anger this indicates that the higher the accuracy on the EF was related to less expression and shorter expression of anger. This in turn may be due to the child's ability to employ

response inhibition. Because Less is More was the only task significantly related to expression of emotion this suggests that Less is More was the best measure of response inhibition. Though Peg Tapping is thought to tap into response inhibition (Blair et al., 2004) accuracy on the EF task was not significantly related to reduced anger or frustration. This finding further supports the idea that Less is More is a better measure of response inhibition. Because DCCS is not a measure of response inhibition but rather of set shifting, we did not predict a relation between accuracy on DCCS and expression of emotion. Results did not indicate any relation between number correct on the DCCS task and the expression of emotion. Thus, it seems that set shifting (measured by DCCS) is not related to the expression of emotion.

Emotion Regulating Strategy Use

Is accuracy on EF tasks related to the use of emotion regulating strategies, particularly more distraction and less support seeking? Our results suggested the number correct on Peg Tapping was related to the maximum bout length (duration) of support seeking. In other words, as accuracy increased on Peg Tapping, the duration of support seeking during the wait also increased. This result may be due to the ability to use working memory. Perhaps the child's ability to remember how many times to tap also allows the child to remember the surprise for a longer period of time. It may be that it becomes harder to stop seeking support from "mom" when the child is continuously thinking about the surprise. Furthermore, accuracy on the DCCS task related to latency to first bout of support seeking. A reason for this outcome may be that the child may have other means of regulating anger (e.g. self distraction). DCCS requires the ability to shift mindsets and attention (Frye et al., 1995). Perhaps, if a child is able to shift attention they may shift away from the frustrating situation (not being able to open the surprise) and regulate using self distraction rather than distracting the mother from her work and causing her to take longer on the questionnaire. Number correct on Less is More was not related to the use of support seeking. Maybe this result is due to the nature of the task. Perhaps, Less is More taps mainly into complex response inhibition when used to regulate affect. If this is the case, then the employment of support seeking is not related to affectively activated response inhibition or to accuracy on Less is More.

Accuracy on DCCS inversely related to average maximum duration of bout for focused distraction. At first the inverse relationship between DCCS number correct and maximum duration of bout was surprising. Because DCCS tests for set shifting we thought indices of focused distraction would be positively related. However, accuracy on DCCS is thought to be governed by the ability to set shift. This in turn allows a child to be able to shift from one mind set to another. Perhaps, if a child can set shift they may be able to shift away from the initial distraction back to the surprise or to another distracting object more readily. That is to say that as a child's ability to set shift increases so does their ability to shift out of distractions more quickly, thus making duration to the maximum bout shorter. Accuracy on Peg Tapping and Less is More tasks did not relate to the emotion regulating strategy distraction. Perhaps the lack of relation is due to the nature of these EF tasks. Peg Tapping requires inhibition and working memory but it has not been proven to involve set shifting. Less is More requires complex response inhibition but does not require set shifting either. The DCCS task is the only task that

requires set shifting and is the only task that related to distraction it appears that set shifting is related to the use of distraction as an emotion regulating task.

Ultimately relations among EF tasks supported our hypothesis of EF as a multidimensional construct. Accuracy on Less is More was related to the expression of anger and the maintenance of a neutral state. Accuracy on Peg Tapping was related to the maximum bout length (duration) of support seeking. The number correct on DCCS was related to latency to first bout of support seeking and inversely related to average maximum duration of bout for focused distraction.

Limitations

Even though we found significant correlations among some of our variables that supported our hypotheses, the data was based on correlations. Because correlations do not necessarily indicate causation we can not be certain of which variables are affecting the others. We do not know if it is executive function that is assisting in emotion regulation or the ability to regulate emotion that affects EF development. Furthermore, working memory is believed to underpin most executive skills (Roberts & Pennington, 1996). Because working memory may influence most executive skills we can not know for certain which components of EF are being measured with the tasks previously described. Finally, sample consisted of one social economic status (SES). Participants were from low income rural families. Because of this, the sample might not be reflective of the entire population.

Future Directions

In summary, the present study suggested a weak to moderate relation among EF tasks. Results also suggested a link between accuracy on Less Is More, expression of anger and maintenance of emotion. The number correct Peg Tapping was related to the maximum bout length (duration) of support seeking as a strategy. Lastly, accuracy on the task DCCS was related to latency to first bout of support seeking and maximum duration of bout for focused distraction. Future research should focus on finding further evidence to support executive function as a multidimensional construct. Future studies should also focus on finding ways to test for emotion regulation behavior (e.g. strategy use) that will be able to be analyzed by multiple means (e.g. correlation, linear regression, etc.). Such findings have implications for the understanding of the role of emotion regulation in adjustment and maladjustment of children and the development of future intervention techniques as well as the development of better teaching techniques.

48

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Table 1
Correlations among three Executive Function Measures

	DCCS	Less is More
Peg Tapping	0.31**	0.30**
DCCS	-	0.11

**p < .01.

Table 2
Correlations between EF Accuracy Scores and Indices of Emotion Expression

	Peg Tapping	DCCS	Less is More
Anger			
No. of epochs	-0.11	0.10	-0.14
Average No. of bouts	-0.04	-0.06	-0.20*
Average bout length	-0.07	-0.07	-0.17*
Maximum bout length	-0.08	-0.04	-0.18*
Latency to first bout	0.02	0.14	0.14
Neutral			
No. of epochs	-0.09	-0.15	-0.11
Average No. of bouts	0.14	-0.01	0.16*
Average bout length	0.12	-0.90	0.18*
Maximum bout length	0.05	0.07	0.05
Latency to first bout	0.06	-0.12	0.14

*p < .05.

Table 3
Correlations between EF Accuracy Scores and Indices of ER Strategy Use

	Peg Tapping	DCCS	Less is More
Support Seeking			
Average No. of bouts	0.02	-0.03	-0.09
Average bout length	0.14	-0.06	-0.04
Maximum bout length	0.18*	-0.03	-0.09
Latency to first bout	0.10	0.21*	-0.03
Focused Self Distraction			
Average No. of bouts	0.06	-0.14	0.10
Average bout length	0.03	-0.13	0.10
Maximum bout length	0.03	-0.19*	0.12
Latency to first bout	-0.12	0.04	-0.10

*p < .05.

Oil Prices and Violent Conflict: Is There a Connection?

Blake E. Garcia, McNair Scholar, The Pennsylvania State University

Faculty Research Advisor: Dr. Robert B. Packer
Associate Professor of Political Science
Department of Political Science
College of Liberal Arts
The Pennsylvania State University

Abstract

"Resource curse" literature has neglected to directly seek a connection between movements in oil prices and violent conflict. This study finds, using a pooled cross-sectional time series design, from 1970-2006, covering 25 oil-dependent countries, that these countries tend to experience an increase in the likelihood of the onset of domestic armed conflict when oil prices are increasing and a lower likelihood of conflict when oil prices are decreasing. It is also found, contrary to recent literature, that the level of oil dependence may not be an indicator for the likelihood of conflict.

1. Introduction and Literature Review

Resource curse literature generally tends to examine how resource dependence affects the likelihood of conflict, often along with an ancillary argument examining how fluctuations in resource prices affect democratization. An area that this literature has neglected to address is the connection between movements in oil prices and violent conflict. Although the United States imports much of its oil from both Mexico and Canada, it is also heavily dependent on foreign oil in many politically unstable countries, including Venezuela, Nigeria, and Saudi Arabia. When oil prices increase, due to a greater global demand, states that depend on the export of oil will accrue greater revenues, allowing those in power to both co-opt, through patronage, those who can help maintain the power of the state and repress opponents of the regime, likely to rebel. This, in effect, should decrease the likelihood of civil conflict and heighten the state's desire for higher oil prices in oil-producing areas. Because the United States depends on the import of oil from many of these oil-producing states, consumers must pay the higher prices. This study presents empirical evidence suggesting, in fact, that oil-dependent countries (those dependent on the export of oil), tend to experience an increase in the likelihood of the onset of domestic armed conflict when oil prices are increasing and a lower likelihood of conflict when oil prices are decreasing. Contrary to recent literature, this study also suggests that the level of oil dependence may not be an indicator for the likelihood of conflict. To more effectively approach the question of how movements in oil prices affect the onset of conflict, it is appropriate to examine the current resource curse literature that allowed this question to arise: How resource dependence affects the

likelihood of violent conflict along with an additional argument often discussed in this body of literature, claiming that fluctuations in resource prices affect democratization.

Many scholars claim that resource dependence affects the likelihood of violent conflict (Ross, Hegre, de Soysa). This claim is also known to be part of the larger paradox of the "resource curse," adding to the many potential downfalls of resource wealth. Collier & Hoeffner (2002a), using 52 civil wars between 1960 and 1999 and measuring natural resource dependence as the ratio of primary commodity exports to GDP, suggest that primary commodity exports tend to increase the likelihood of civil war but only up to a ratio of 32%. Levels of export beyond this tend to lessen the likelihood of conflict because government control over the natural resources tends to curb rebels' financial opportunities, raising the cost of a rebellion. When a resource is more available (past 32% of GDP) the government is able to surpass rebel manpower, gaining greater control over the resource. Although employing a different set of control variables, Hegre (2002) finds similar results, though cautioning that primary commodity exports may be somewhat less important than previously suggested. Intriguingly, with very limited deviation, scholars generally agree that oil is most highly associated with the onset of conflict (Ross, 2004). Collier & Hoeffner (2004), de Soysa (2007), as well as Fearon & Laitin (2003) all find that oil is significantly linked to civil war, particularly secessionist war, and that countries deriving at least 1/3 of their exports from oil double the risk of conflict. This effect could be due to the economic downfall of "Dutch disease," where currency values rise because of increased resource exports, making manufactured and agricultural exports less assertive. This causes the country to be significantly more dependent on its resource sector, becoming even more susceptible to the inconsistency of the international market (Lam & Wantchekon, 2003). Rogoski's conflict coalition model may provide a demonstration of this effect where land is substituted by commodities: When trade is expanding, a government in a country relatively abundant in land (commodities), will benefit from trade, maintaining a more dominant position. This could potentially diminish the assertiveness of other sectors in the economy (manufacturing), causing slower economic growth. Ross (2001b) finds a significant correlation between oil dependence and higher child mortality rates, which may also make a country more susceptible to internal conflict. When governments provide poor education and healthcare, people are more likely to be recruited by rebel groups and thus, rise up against the state.

Regime type also plays a role in civil conflict. Because of the conflicting views as to whether democratization leads to civil peace (Hegre et al, 2001; Fearon, 2003), Hegre conducts a study arguing that there is a curvilinear relationship between regime type and likelihood of civil conflict, resembling an inverted U-shaped curve (Hegre, 2001). This relationship is formed using a scale ranging from an extreme autocracy to a fully liberal democracy, which at both ends are expected to have relatively low levels of civil conflict. Regimes in between the two extremes, "anocracies," are expected to have far greater levels of civil conflict. Regimes in transition are also expected to have higher levels of conflict (Hegre, 2001). There seems to be much empirical evidence within the resource curse literature suggesting that countries dependent on natural resources experience a higher likelihood of conflict, and an ancillary argument, claiming that fluctuations in resource prices affect democratization, adds to the complexity of this paradox.

Commodity prices, particularly oil prices, have risen significantly over the past two years and have been increasing since the 1990s. *New York Times* correspondent Thomas Friedman, in his 2006 *Foreign Policy* article, "The First Law of Petropolitics" brought attention to a relationship between oil price movements and democratization. More specifically, he argues that the price of oil and democratization move in opposite directions. In other words, the higher the price of oil, the more that democratic trends are eroded. Conversely, the lower the price of oil, the more democracy is strengthened. Friedman's article offered a new twist on the long established "resource curse" argument, which claims that countries heavily dependent on the export of natural resources tend to suffer from slow economic growth, high poverty rates, corruption, and authoritarian governance (Ross, 2004). The case of Nigeria is an excellent example. When the price of oil was roughly $25 per barrel in 1999, Nigerian President Olusegun Obasanjo came to office with the People's Democratic Party and ended decades of military rule. He released political prisoners, spoke out against human rights, decreased the national debt, and was taking the country in the direction of tremendous democratic reform (Friedman, 2006; Isaacs, 2002). Though, as oil prices surged toward $60 per barrel, democratic institutions began deteriorating, political opponents were killed, and legal and educational structures became entrenched with corruption. This is a common trend, though the mechanisms connecting this relationship vary (Friedman, 2008).

Ross (2001) uses the "rentier effect" argument to show how, in three ways, governments use the rents they generate from oil to relieve social pressures for greater accountability. First is the "taxation effect." When there is a greater demand for oil in the international community, oil prices rise and oil-producing states accrue a greater stream of revenue. Due to a greater influx of cash, governments are less likely to tax their citizens, creating less of a public demand for accountability from and representation in the government. Second is the "spending effect." In authoritarian regimes, the dictator lives in constant fear of losing office. In order to stay in office, the ruler must maintain the support of the people who can contribute in perpetuating his current office—the winning coalition, in effect, buying their loyalty. When a government accrues greater revenues due to higher resource prices, they will disperse those rents as private benefits only to the winning coalition. Because this income is so heavily spent on patronage, very little money is spent on public goods of infrastructure and education, and average incomes tend to be very low, further impeding pressure for democratization. Third is the "group formation" effect. The government may use its bounty from oil revenues to deter the formation of political or social groups, create institutions that support the political goals of the state, and depending on the state, will do so in a direct or allusive manner. In agreement with Ross, Jenson and Wantchkon state that what links authoritarian governance and resource dependence (and more so with a greater demand of the resource) is the incumbent's discretion of the rents. Using Dahl's diffusion of power to explain Ross's mechanisms, Hegre (2003) states that there are generally very few people involved in extracting the resource rents and power is disproportionately distributed to the state. This creates a poor condition for democracy. Because resource wealth is often mismanaged by the ruling elite, economic problems generally arise, creating another link between resource prices and democratization.

Many scholars attribute economic development to the outcome of democracy (Lipset, 1959; Dahl, 1989). Lipset (1959) stated, "the more well-to-do a nation, the

greater the chances it will sustain democracy." This may include levels of education and average income, amongst other indicators. Dahl (1989) argues that a 'modern dynamic pluralistic society is important for establishing a stable democracy because it allows for a dispersion of political resources, strategic locations, and bargaining positions. Ross (2001) posits another mechanism from a development standpoint in which he terms the "modernization effect." This argues that occupational specialization, urbanization, and higher levels of education within a country are key factors in impacting the likelihood of democratization. Resource-led growth, ironically, does not lead to these factors. Lipset (1959) argues that higher levels of income and education would lead to a more rational, "compromise-oriented" view of politics and would produce a more articulate and autonomous public, making it more difficult for elites to exploit the political system. It would not make a difference if a free press is vital to a democracy if the majority of the population is illiterate. When there is an increase in literacy rates, income levels, and other developmental indicators, there ultimately becomes a greater pressure for democratization.

The oil booms of the 1970s brought oil-rich countries tremendous wealth but over the following decades, countries with what was thought to be remarkable promise, remained in completely depressed and stagnant economies (Ross, 2008). Again, it is not the simple presence of a resource that may lead to political and economic downfalls, it is how the resource is managed. Very few oil-rich countries have the financial knowledge to properly manage a sudden glut of revenues. This can be seen in both Kazakhstan and Nigeria, where instead of providing basic needs to villages throughout the countries, the central governments spent the rents on building new capital cities (Ross, 2008). This wealth of literature shows that there is clearly a relationship between the price of oil and democratization, though there are various factors that link this connection. Another body of research, further expanding on the already established "resource curse" literature examines how countries heavily dependent on natural resources, particularly oil, may be more susceptible to the risk of conflict.

2. Theoretical Argument

Resource curse literature, examining the connection between resource dependence and the likelihood of violent conflict, as well as a supporting argument showing the apparent trend between fluctuating resource prices and democratization have become more important in recent decades due to a growing demand. Though, what has been hinted towards but not directly mentioned is how fluctuations in resource prices affect the likelihood of conflict. It is not the simple presence of the resource that raises the risk of conflict, rather, it is how the resource is managed. An example of this relationship can be seen in the rational peasant argument where there is a dyadic tie between patron (ruling elite) and the client (peasant) in corporate villages. The patron often prevents the spread of literacy and peasants' involvement in expanding markets, reducing the potential decrease in peasant dependence. Although the patron may be accruing greater rents due to price increases, to lessen the bargaining power of the peasant, the subsistence floor price (that which the peasant receives) will remain the same, giving the peasant a greater incentive to rebel (Popkin, 34).

The rentier state literature may also explain this relationship. To the extent that there is an expansion in trade, due to a greater demand in particular resources, the price of those resources will rise. States that depend on the export of these resources will generate greater revenues, allowing more money for the state to both co-opt, through patronage, those who could potentially maintain the power of the state (winning coalition), and repress the opponents of the regime (others within the selectorate). In a democracy, there is a much larger winning coalition within the selectorate, providing public goods in which nearly everyone benefits. In an autocracy, there is a smaller winning coalition, providing only private goods, creating greater antagonism between this winning coalition and the masses because only the elite are benefiting. Potentially, this could mean that lower resource prices would raise the likelihood of conflict and higher resource prices would lessen the likelihood of conflict. When prices decrease, there is less money for the state to co-opt members of the winning coalition, making them more susceptible to support the political challenger because they would not be receiving as many private goods. There will also be less money to repress the opponents of the regime, allowing them to more easily rise up and rebel (Bueno de Mesquita et al, 37-73).

Haber (forthcoming), in line with this theoretical framework further expands on the rentier state argument, claiming that natural resource wealth where the government is generating greater rents in an already authoritarian regime may, in fact, further fuel that autocracy, preventing democratization. Dictators are inherently insecure because not only do they face potential regime challenging rebel groups, but they also constantly face political challengers and political entrepreneurs who lead organized groups. Dictators cannot simply push out these organizations because first, an organized group is often needed in order to take power, and second, the launching organization is needed to run the country, so it is integrated into the state. Though, the dictator still lives in fear that the launching organization's self-interested leaders will use it to launch their own bids for power. Because the ultimate goal for a dictator is to stay in power, he will both terrorize the leadership of the launching organization (mostly members of the winning coalition), as well as co-opt this leadership, as mentioned previously.

The dictator may terrorize through murder, torture, and purges. Organization members have an incentive to denounce one another to save themselves, making it difficult to cooperate and act against the ruling party. Because of this the dictator may not know whether the denunciations are accurate so he purges indiscriminately. This, tactic is, of course, a way to prevent anyone from challenging and attempting to overthrow the regime. A more common strategy is co-opting the leadership by buying their loyalty. Similar to the "spending effect" identified by Ross, there must be a source of steady rents. These rents are paid to the winning coalition, convincing them that they are better off cooperating than challenging the regime, or lending their support to other incumbent challengers. Haber states that the organization "will only join a coup attempt if they believe that the stream of rents they will earn post coup, multiplied by the probability of the coup's success, minus the cost of losing their heads if the coup fails, exceeds the stream of rents they already earn." When oil prices increase, the state has more money to keep the winning coalition happy and to continue repressing opponents of the regime, making conflict less likely. Though, when oil prices fall, there is less money to disperse, allowing members of the winning coalition to question whether they should

support a political opponent and less money to repress regime challenging groups, raising the likelihood of conflict.

More states depend on oil than any other commodity and this demand will only continue to rise. The "resource curse" literature shows both an inverse relationship between oil prices and democratization as well as how a greater dependence on oil seems to raise the risk of conflict. The goal of this study is to examine the gap: how movements in oil prices may affect the likelihood of the onset of domestic armed conflict.

H$_1$: When oil prices decrease, I expect an increase in the likelihood of the onset of domestic armed conflict.
H$_2$: When oil prices increase, I expect a decrease in the likelihood of the onset of domestic armed conflict.

3. Research Design

The hypotheses are tested using a pooled cross-sectional time series regression model covering 24 oil-dependent countries during the 1970-2006 period. Testing for the onset of domestic armed conflict, this study utilized the CSP-Major Episodes of Political Violence dataset which identifies all major conflicts with a total of 25 or more battles deaths over the course of a single year during the post-World War II era, 1946-2007 (Marshall, 2008). Oil prices were taken from the economic time series section of economagic.com. The prices were measured as global yearly averages and were inflation adjusted through a GDP deflator set to represent constant 2006 US dollars. Because global oil prices were relatively flat prior to 1970, this particular 37 year time span was used to more closely examine the more varying fluctuations in prices. The log of oil prices was used as the independent variable to measure the movement, upswing, or downswing of the averages year to year, as opposed to measuring the prices themselves.

Control Variables

Oil Dependence: This oil dependence variable was taken from the World Development Indicators of the World Bank (2007) and was measured as total fuel exports as a percentage of merchandise exports. In line with Hegre (2003), is seemed more appropriate to divide by total merchandise exports as opposed to GDP because exports/GDP tends to be correlated with the size of the economy which varies in size. Dividing by merchandise exports provides the importance of oil relative to the state's economy.

Regime Type: The regime type variable was taken from the Polity IV Annual Time Series Regime Authority Characteristics and Transitions Dataset (Jaggers & Gurr). Each country in the study was given a polity score which captures the regime authority spectrum on a 21 point scale measured from -10 to 10. This spectrum spans from fully institutionalized autocracies through mixed or "anocracies" to fully institutionalized

democracies. Regime type as a variable in this study should be seen more as a proxy for stability, where the more stable a country (polity is close to either extreme), the lower likelihood of conflict.

Income: The income or GDP per capita variable was taken from the World Development Indicators of the World Bank (2007) and was measured in constant 2000 US dollars.

Infant Mortality Rate: The infant mortality variable was taken from the World Development Indicators of the World Bank (2007) and was measured as total number of deaths of children under 5 per 1,000. This variable is more generally used as an indicator for development. It would therefore be expected to see an inverse relationship between mortality rates and a conflict, where the more developed is a country (meaning lower infant mortality rates), the less of a likelihood of conflict. Literacy rate was originally used with preliminary regressions but was dropped from the study due to multi-collinearity.

4. Results

Table 1: Oil Prices and Domestic Armed Conflict, 1970-2006

Independent Variable	Model 1	Model 2
Oil Prices$_{Log}$	0.042**	0.933
	(.02998)	(.00154)
% Fuel/Exports	0.300	0.287
	(.00024)	(.00028)
Polity	0.012**	0.752
	(.00280)	**(-.00038)**
GDP per Capita	0.276	0.023**
	(1.75e-06)	(-3.96e-06)
Infant Mort. Rate	0.001*	___
	(.00041)	

P-Values with **, *, indicate significance at the .05 and .01 levels, respectively. Coefficients in parentheses suggest the direction of relationships.

60

Table 1 estimates the effects of fluctuating oil prices on the likelihood of the onset of domestic armed conflict over a thirty seven year time period. Both models include the P-Values and coefficient levels. The positive coefficients suggest a positive relationship between the independent variables and the dependent variable. Results in Model 1 used a basic multivariate regression. Results in Model 2 used a basic multivariate regression containing a three year lagged dependent variable and omitted the infant mortality rate.

Movements in oil prices seems to exert a positive effect on the likelihood of the onset of domestic armed conflict, which may support the hypotheses posited in the theoretical framework of this study, and a possible argument for this will be discussed. As previously suggested throughout earlier parts of the paper, total fuel exports as a percentage of merchandise exports (the measure for oil dependence) has no significant relationship in affecting the likelihood of the onset of conflict. Although many scholars in agreement with the common "resource curse" argument generally agree that oil dependence, among a variety of other natural resources dependencies and primary commodities, increase the likelihood of *civil war* up approximately 32 per cent, this study suggests that there is no relationship above or below the 32 percent threshold for raising or lessening the likelihood of conflict. This means that the level of oil dependency seems to have no real effect in the likelihood of conflict, which opposes much of the literature.

GDP per capita, used as an indicator for average income levels only shows a significant relationship when lagged by three years and with the omission of infant mortality rates. There is a negative relationship, meaning that when average income levels increase over a period of three years, the likelihood of the onset of domestic armed conflict lessens and when average income levels decrease over three years, there is a heightened likelihood of conflict initiating. Though, in Model 1 where no variables are lagged, there is no significant relationship between average incomes and conflict. This is in line with what would be expected. Once average incomes raise "enough" (in this case, three years) the effects will be seen. Otherwise it would not be expected that a same-year or one year change in income levels would have any significant effect on conflict.

The positive relationship between infant mortality rates and the onset of domestic armed conflict suggest that when infant mortality rates increase, so too does the likelihood of conflict. Because mortality rates are more of a general indicator for development, the relationship can better be seen as one where the onset of domestic armed conflict is more likely the less developed a country and less likely the more developed a country. This significant relationship is clearly in line with what is expected and serves more to validate the current literature.

A more interesting result concerns the relationship between regime type (polity level), which is, of course, used more as a proxy for stability, and the likelihood of the onset of domestic armed conflict. The results in Model 1, suggest that as the polity score increases (moving upwards on the scale from -10 to 10), the likelihood of conflict increases. This essentially means that the process of democratization increases the likelihood of the onset of domestic armed conflict. The majority of the sample of countries in this study begins with a polity score of -7 or below (around 1970), which would be considered a quite stable autocratic governance, and end with a higher score (-2 for example, in 2006). Fewer in the sample begin with a polity score in the mixed or anocratic regime category (between -6 to 6) and even when ending in the 7-10 polity range (a more stable democracy), the process of democratization still greatly heightens

the risk of the onset of conflict during that particular span of time. This finding further validates the inverted-U relationship as it relates no not only natural resources as a broad category but to oil more specifically. The U-curve relationship also more generally refers to civil war as the outcome variable but this study confidently expounds on this argument to include the likelihood of the onset of domestic armed conflict as a potential outcome variable as well.

The majority of the resource curse literature finds that higher levels of oil dependence, measured as fuel exports as a percentage of total merchandise exports or as a percentage of GDP, raises the likelihood of armed conflict but only up to 32 per cent. Once this threshold is met, the likelihood of conflict begins to lessen. Smith (2004) argues the opposite, that higher levels of oil dependence, past this threshold makes authoritarian regimes stronger (more durable) through the greater ability to fund patronage networks and repression, in effect, reducing the likelihood of armed conflict. Contrary to both lines of literature, the results of this study indicate the level of oil dependence is not a contributing factor to the likelihood of conflict because the onset of conflict seems to occur equally above and below this threshold, meaning that regime-challenging conflicts must be distinguished from secessionist conflicts.

As mentioned in the first finding, results show that there is a positive and significant relationship between movements in oil prices and the likelihood of the onset of domestic armed conflict, which contradicts the hypotheses. This suggests that as oil prices increase year to year, there is a higher likelihood of conflict initiating. When oil prices decrease from year to year, there is a lower likelihood of conflict. However, the types of armed conflicts are not differentiated in the theoretical argument. Le Billion (2001) says that resource rents constitute the "prize" for controlling the state, which, of course, may lead to coup attempts or other violent means to attain political control, winning the "prize" and thus the distributive capability of the resource rents. If oil is both point (which it is) and proximate (meaning close to the capital), a decrease in oil prices should lead to a higher likelihood of the initiation of regime-challenging domestic armed conflict. Again, the state would have less money to both co-opt members of the winning coalition and repress those opponents of the regime who are also close to the capital and are competing for control for the "prize," being oil rents.

If oil is both point and distant (meaning away from the capital) and oil prices increase, there should be a higher likelihood of the initiation of secessionist domestic armed conflict because those who live close to the oil (far away from the capital) believe that they should control those oil rents instead of having the perceived "outsiders" control their local resources. Because of the distance from the capital, it would be easier to attempt to secede from the country as opposed to try and overthrow the current political leader. The environmental costs of the extractive industry (of which is often state controlled) may also give incentive to the locals to secede, though still with the intentions of having local control over the particular resource.

5. Conclusions and Implications for Future Research

It is important to point out that this study serves as more of a baseline on which future research should be built. The resource curse literature has grown tremendously

throughout the past decade but has failed to question the connection between the movement of oil prices and intrastate conflict. Instead, most studies attribute the level of oil dependency as the main indicator for conflict.

The results of this study indicate that oil dependent countries in general have a higher likelihood of experiencing the onset of domestic armed conflict when oil prices are increasing and have a lower likelihood of experiencing the onset of domestic armed conflict when oil prices are decreasing. Also, contrary to recent literature, the level of oil dependency does not seem to be an indicator for conflict.

Future research should not only vary the use of datasets in examining the onset of domestic armed conflict but should also look at how movements in oil prices affect the duration, severity, and intensity of conflicts, as well as the effects on interstate conflict. The temporal domain in this study roughly began after the fairly flat movement of global oil prices in 1970. Although this length of time covers the major historical booms and busts of oil prices, a longer time span should be used to see the difference with relatively flat movements in prices.

Because there is question as to what type of domestic armed conflicts are occurring in this sample (regime-challenging or secessionist), an intensive case study analysis should be included to classify these particular conflicts and to see whether there is a relationship between the upswing and downswing of oil prices to the outcome of either type of conflict. This study shows a positive relationship between the variables, which would indicate secessionist conflict but does not verify each to conclusively show that this is the case. In some cases, multiple armed conflicts occur in a single year and are not able to be distinguished in a yearly regression model so it may be important to measure both monthly start dates and monthly average global oil prices to better validate the relationship to the onset of conflict.
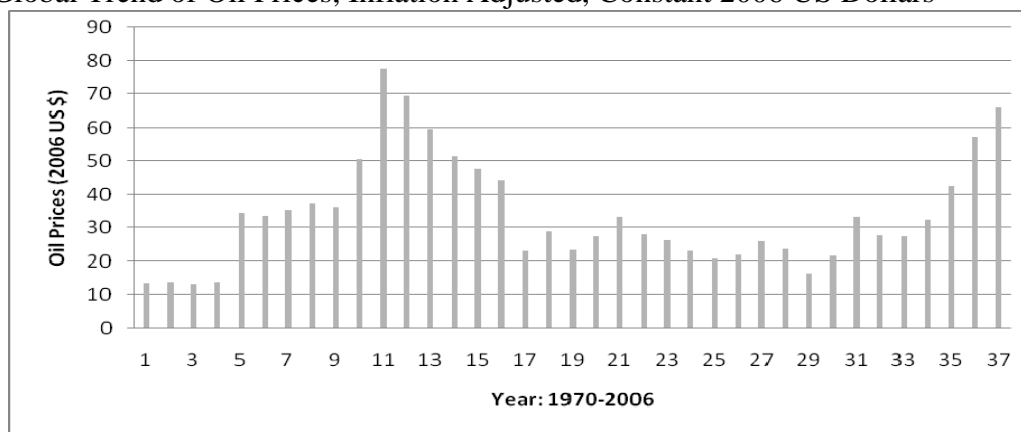
Appendix A

Oil Dependent Countries*

1. Algeria	98
2. Nigeria	98
3. Angola	95
4. Oman	95
5. Yemen	94
6. Libya	93
7. Venezuela	93
8. Kuwait	92
9. Qatar	91
10. Saudi Arabia	91
11. Congo, Rep.	88
12. Gabon	86
13. Azerbaijan	85
14. Iran, Islamic Rep.	83
15. Bahrain	81
16. Kazakhstan	69
17. Cameroon	62
18. Ecuador	59
19. Egypt, Arab Rep.	56
20. Bolivia	52
21. Colombia	40
22. Syrian Arab Rep.	40
23. Iraq	34
24. Indonesia	27

*Oil dependence is measured by fuel exports as a percentage of merchandise exports based on 2006 or most recent figures available from the World Bank (2007) World Development Indicators.

Appendix B

Global Trend of Oil Prices, Inflation Adjusted, Constant 2006 US Dollars

Appendix C

Summary of Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Domestic Armed Conflict (onset)	819	.030525	.172132	0	1
Oil Prices$_{Log}$	819	3.426573	.4524377	2.580217	4.351181
Fuel Exports (As a % of Merchandise Exports)	628	63.07484	32.41972	0	193
Polity	819	-4.423687	6.278186	-10	9
GDP Per Capita	711	3,671.471	5,232.07	235	40,052
Infant Mortality Rate	193	91.66321	71.41673	10	280

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The IMF and Latin America: A Comparative Case Study Analysis of Mexico, Argentina, and Venezuela

Victoria Marie Jackson, McNair Scholar, The Pennsylvania State University

Faculty Research Advisor: Dr. Mark Anner
Assistant Professor of Labor Studies and Employment Relations
Department of Political Science
The Pennsylvania State University

Abstract

  The fundamental framework and neoliberal ideals of the International Monetary Fund weaken developing nations rather than encourage economic independence. I plan to show that the neoliberal efforts and ideals of the IMF are not linked to the development of México, Argentina, and Venezuela, but are linked to increased levels of dependency. This study will thoroughly examine the impact of the IMF and analyze these countries' responses to the IMF. México pursued the most conservative course by embracing neoliberalism, Argentina displayed a moderate approach, and Venezuela pursued the most radical advance. This article documents these responses and analyzes the best approach.

  Globalization is the growing interconnectedness of countries through trade, communication, culture, and the rapid exchange of ideas. While globalization and free trade idealism has largely benefited the global elite, there have negative effects on underdeveloped countries. It has created a stagnating inequality within countries all over the world including those of Latin America. While few benefit from the cheap labor and constant expansion of multi-national corporations, it is always at the cost of many. Many are currently living in poverty, in particular those of underdeveloped countries. Meanwhile, those in support of free trade liberalism fail to consider the millions living in poverty. Due to the fact that globalization is such an overarching world phenomena, many argue that no one conclusion can be drawn to pinpoint the negative effects the current state of the economy has on the poor. I hypothesize that it is possible to draw conclusions concerning the International Monetary Fund, as a primary actor in the current state of globalization, and its negative effects on developing countries such as those of Latin America. The International Monetary Fund attempts to maintain global stability, and this is impeded through the implementation of neoliberal conditionalities and reforms.

  While many argue in defense of globalization, many are against the neoliberal ideals of globalization, and this has created an ongoing debate in past literature. Joseph Stiglitz is an American economist who examines globalization and free trade critically. In his book *Globalization and its Discontent*s he argues that those living in poverty have gained little to nothing, and that many are worse off (Stiglitz 2003, 2002). On the other hand, those such as Friedman and Bhagwati argue such theories as globalization having positive effects on the global economy and also that the globalization debate is

68

exaggerated. In an interview, Bhagwati suggests that developing countries can use "globalization as part of a reform agenda that would advance prosperity, increase skill formation and be a force in reducing poverty and distress among the poor"(Bhagwati 2006). In his book *The Lexus and the Olive Tree*, Friedman argues for globalization and states that conflict arises due to the tension between the globalization system "the lexus" and ancient forces of culture, geography, tradition, and community "the olive tree"(Friedman 2000).

The globalization debate is not exaggerated. It may be a "buzzword" but in spite of this it explains an entire economic phenomenon that is currently taking place in the global economy. I argue that globalization solely benefits the elitist of the current global economy, and agree that Stiglitz is correct in stating that there is no world government to oversee the profit-making institutions such as the IMF (Stiglitz 2003, 2002). The IMF promotes an economic strategy that encourages capitalistic ideals and supports the idea of "comparative advantage." Odious debt, and continuing loans from the IMF with numerous conditionalities inhibit a true system of comparative advantage because developed countries will always have an advantage over poorer countries. However countries of Latin America have responded distinctly, and this is how I have chosen the three units of analysis. Mexico has demonstrated a conservative approach by accepting the free trade ideals of the IMF. Venezuela, on the other hand has completely severed all relations with the IMF while arguing for an alternative institution in which developing countries first unite on a regional level before establishing more free trade agreements with developed countries. Meanwhile, Argentina has shown a more moderate approach between the two countries, agreeing that globalization is acceptable but that there is a need for reform in the current state of the economy.

In the sections that follow I will first review previous literature on this research, and provide my argument in response. Secondly, I will explain the methodology of this study, and how I plan to prove my argument. Next, I will explain the history and functioning of the International Monetary Fund as a global governing institution. I will explain the lending process of the International Monetary Fund, and the many factors that contribute to this process. I will show why these relations and loans have created a dependency throughout Latin America. Subsequently, I will explain the conditionalities of these loans distributed by the IMF. Then, I will analyze the outcomes of these various loans distributed throughout Mexico, Argentina, and Venezuela. Lastly, I will analyze the three responses to globalization and make the argument that greater integration and unity among developing countries is the best approach.

The Globalization Debate

Many have contributed to the globalization debate, including Stiglitz, Castells, Bhagwati, Freidman, and Harvey who argue against globalization. Manuel Castells is against the modern state of globalization, and explains the current situation of the economy to be that of a network society in which there are "spaces of places" and "spaces of flows"(Castells 2000). He explains that due to this new globalized world, people are in turn entrapped in these "spaces of flows" or global cities because they do not possess the means to acclimate to the global elites. Entrapped people are defined as working class and poor individuals (Castells 2000). Castells explains that while the

global elites profit from these global cities the working class citizens remain entrapped. This is because while elites possess the means to constantly travel and expand, the poor are constantly being subjugated to exploitation. This enforces the idea that globalization has negative effects on underdeveloped countries.

In addition to Castells, Harvey argues against globalization. In "Spaces of Global Capitalism: Towards a Theory of Uneven Development" Zieleniec reviews various works that debate the current issue of globalization. He describes that while some believe the term globalization is hackneyed, others continue the debate as they believe it is the only productive solution to solving the current matters of the economy (Zieleniec 2007). Harvey's "New Imperialism" provides a basis for understanding and analyzing current debates on globalization(Harvey 2005). David Harvey's ideals on the New Imperialism, include "accumulation by dispossession", and also the idea of "spatio-temporal fixes"(Zieleniec 2007). Accumulation by dispossession defines the idea that in the current global economy capitalism forces the corporate world to seek outside of itself in order to expand beyond their nation-states. In order to expand they must accumulate goods by dispossessing others of their land and goods. Spatio-temporal fixes are these areas in which businesses seek to expand, when their current economic situation is enduring stagnation. This current system benefits the elite, while exploiting the many.

Jagdish Bhagwati and Thomas Freidman among others argue for globalization and against the argument of its negative effects on poorer countries. In his book *In Defense of Globalization,* Baghwati argues that the various social causes that we all embrace, such as gender equality and reduction of poverty, are advanced, not set back by globalization (Bhagwati 2004). He does not agree that globalization has caused higher levels of poverty but that it has improved the standard of living throughout impoverished nations.

In his book, *The World is Flat,* Friedman argues that globalization has created a level playing field, and that developing nations are now being able to compete for global knowledge. He states it is an irrefutable fact that more open and competitive markets are the only sustainable vehicle for growing a nation out of poverty, because they are the only guarantee that new ideas, technologies, and best practices are easily flowing into your country(Bhagwati 2004). Furthermore, he suggests that "countries which fall off the development wagon are a bit like drunks; to get back on they have to learn to see themselves as they really are" (Friedman 2005). In addition he states that there should be a club for developing countries to internally inspect failed attempts at developing and they should admit for example, My name is Argentina and I am underacheiving. I have not lived up to my potential. In his opinion development is a voluntary process. Leaders need a positive decision to make the right steps, but it starts with individual countries' self-evaluation.

The IMF Debate

Many have also contributed to the International Monetary Fund debate including those against the IMF. In his article *Causes of the Debt Crisis*, Anup Shah argues that many poor countries today have started their independent status with heavy debt burdens imposed by the former colonial occupiers(Shah 2007). This idea of debt inherited from the past is referred to as odious debt, and while it may be accrued from military

70

dictatorships the IMF. In addition, Shah argues against the IMF in his article Causes of the Debt Crisis. He states that the IMF and World Bank are dominated by Western perspectives and Western interests, and the decisions in Washington often do not correspond to actual situations in developing countries. (Shah 2007).

Nnedu also argues against the IMF. He states that unlike the majority of organizations, the IMF, the World Bank and the IDB are profit-making entities. They are neither charities nor aid agencies – they are profit-making behemoths operating under laws meant to protect nonprofit bodies (Nnedu 2004). In other words there is no world government to oversee these global governing institutions because they operate under laws that support non-profit organizations which are less strictured.

There are also those who argue in favor of the IMF. In his working paper, Guissé argues that the IMF plays a key role in the debt strategy employed by the Paris Club, which relies on the Fund's macroeconomic expertise and judgement to implement one of the Club's basic principles: conditionality. In return, the actions of the Paris Club preserve the status of IMF as a preferential creditor and safeguard the application of its adjustment strategies in developing countries.(Guissé 2004). In other words, he argues that these two institutions create a balanced international monetary system. In addition, he defends the idea of attaching conditionality to IMF loans, and lastly he agrees that the IMF's judgement on policies are most effective in the developing world.

Garrett argues in favor of the IMF by focusing on privatization, one of the IMF's general conditionality requirements. In his paper "The International Monetary Fund and the Global Spread of Privatization, Garrett states that economists argue that privatization increases efficiency by placing decisions in the hands of markets rather than public officials"(Garrett 2003). This is possible through free trade ideals that argue for the invisible hand that will guide the market, and that this has positive effects on the global economy.

The IMF and Dependency

I agree with theorists who argue against globalization. It has negative effects on the poor and the entire global economy as a whole. Of a group of 83 poor countries that received substantial IMF financing between 1978 and 1997, most experienced increased unemployment, a fall in real wages, a more unequal distribution of income, a rise in poverty, a decline in food production per capita, growth in the external debt, and cuts in social expenditures over the time period (Nnedu 2004). IMF loan conditionalities tend to decrease government spending on social programs which increases poverty (and impairs health and education) and leads to lower economic growth.   Because of the contractionary monetary and fiscal policies of the IMF there is a result of less government expenditure on social programs. Because of this there is an increase in poverty, and lastly this leads to a decrease in Gross Domestic Product Growth. Furthermore, I hypothesize that The IMF creates dependency throughout developing nations, and that the most effective way to pursue development is to disentangle relations with these institutions and construct alternative institutions where developing countries have more influence in policymaking.

Past literature on the globalization and also the IMF debate has provided mostly theoretical information, and limited statistical data in explanation for the current phenomenon of globalization. Theorists have taken either a liberal stance against

globalization or a conservative approach in defense of globalization but lack a specific data analysis to prove either case. In this study, I will conduct a comparative case study analysis of three specific Latin American countries and their relations to the IMF. This will be done in efforts to contribute the informative data previous studies have lacked. I plan to argue against those in favor of globalization by showing that the IMF does not foster nation independence, and that it does not encourage development. Conversely, in the long run, a dependency on IMF loans and IMF conditionality tends to increase, and levels of poverty and unemployment across the globe that stagnate their attempts to global stability. To be precise, it is not simply that the IMF ignores poverty; its policies help create poverty. The poor, those living on less than a dollar a day, still remain poor regardless of IMF loans. The long-term effect of the IMF's primary goal to provide loans in the event of economic crisis is not an effective solution but a band-aid to the larger issue of dependency.

I will also argue that in Latin America there have been three dominant responses to globalization and the IMF. The first response is presented by Mexico, which is conservative. The second response is Argentina which has proved a more moderate approach to the IMF. The third is Venezuela which has expedited a radical response to the strictures of the IMF by not only severing its relations to with the IMF, but also by developing an alternative monetary institution to the IMF for developing countries of Latin America. I argue that the response of Venezuela is the most appropriate case because the conditionalities along with the loans of the IMF impede the development of poorer countries, and alternative institutions are needed.

Methods

I conduct this study through a mixed-methodological approach. The quantitative study will be analyzed using time-series data. These dates are mostly from the 1980's to the present measuring and comparing use of IMF credit, public health expenditure, public education expenditure, national poverty rate, and also Gross Domestic Product Growth. This data will be collected from Mexico, Argentina, and Venezuela individually and will then be compared collectively. For data on IMF loans, I rely on the IMF dataset from the website IMF.org. For data on GDP growth, debt ratio to gross national income, central government debt, and public health expenditure I will be using the World Development indicators found on WorldBank.org. The main sources I am using for this data are IMF.org , World Development Indicators, Economic Commission for Latin America and The Caribbean. In this study I will analyze whether IMF loans have an effect on growth, and poverty. My independent variables in this study are IMF loans, and the dependent variables are debt ratio to national income according to the nation's budget, GDP growth, inequality, health care expenditure, education expenditure, and poverty rates.

Past Research has lacked empirical evidence displaying a direct effect of the IMF on developing countries. This study will contribute to past research by providing an analysis of how three specific Latin American countries have responded to the IMF and globalization.

The qualitative study will be a comparative case study analysis including Mexico, Argentina, and Venezuela because they have responded to globalization and the IMF in three particular ways:

Firstly, Mexico has displayed a pro-trade or conservative response to the U.S. and also to the IMF. We see this through the North American Free Trade Agreement that was signed in 1994 with Mexico, Canada, and the U.S. Secondly, Argentina has displayed a moderate or a globalization with reform approach to the U.S. and also the IMF. The country has maintained a consistent relationship with the IMF in the past and also been referred to as the "poster child for reform" in regards to the IMF. Lastly, Venezuela has displayed a progressive approach arguing for Latin American regionalization before complete liberalization with more developed and powerful countries in terms of voting power and GDP.

The IMF

The IMF, formally known as the International Monetary Fund, is a central institution of the current International Monetary System and also a central institution of globalization.
It was established in 1944, and it currently has 185 member states that represent individual nations. Its current loans outstanding (as of 5/31/08) are $19.4 billion to 65 countries(IMF). These IMF loans include conditionality statements which may include privatization, market liberalization, and reduction of government expenditures. "Latin American and Caribbean countries are struggling with very high levels of poverty and income inequality. Millions of people across the hemisphere do not have access to safe water, adequate housing, education and basic health care services. Yet many Latin American and Caribbean countries are burdened by high levels of foreign debt, which severely limits the resources available to their governments to invest in clean water, schools, health care, and the prevention and treatment of HIV/AIDS"(Network).

The IMF Decision Making Process

Voting Power in the IMF's Board of Governors is determined by each country's individual IMF financial contribution (IMF quota), which is determined by a country's economic output. Argentina's current voting power is a mere 0.97%, Mexico's 1.43%, and Venezuela- 1.21%. The U.S. has the largest IMF quota which is 17% (IMF). In addition to further illustrate the current condition of voting power, the highest IMF quotas (U.S.17%, Japan 6%, Germany 6%, France 5%,, Italy 3.2%) total 35% of 185 member countries(IMF). In the voting system of the IMF representatives of the member countries vote, members on The Board of Governors vote when loans are requested. These loans are requested due to many factors including as a result of financial crises, and also balance of payment problems. Many developing nations have to take out additional IMF loans to pay for initial loans to assist in balance of payment problems. "Structural adjustment advice in the past from the IMF and others, has led to the cut back on important spending such as health, education, in order to help repay loans. This has implied a downward spiral and further poverty (Shah 2007). The loans of the IMF may affect countries negatively due to the fact that loan debt and also conditionalities may urge a reduction of government expenditure on social programs.
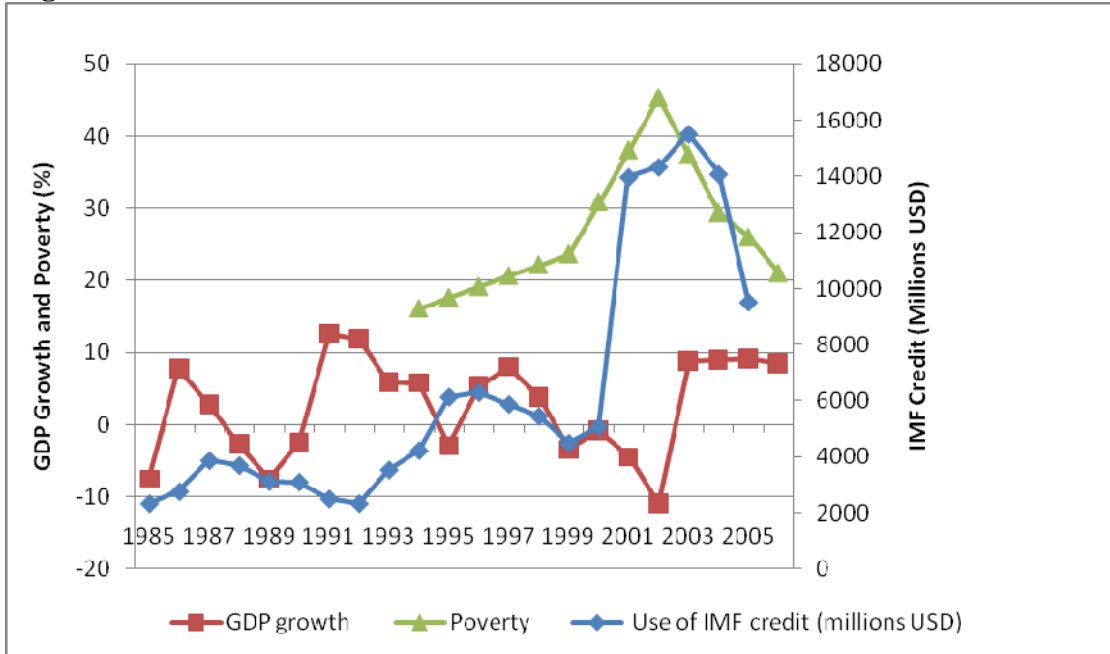
Preliminary Findings

Quantitative- The first three graphs will analyze individual countries use of IMF credit, GDP growth, and National Poverty.
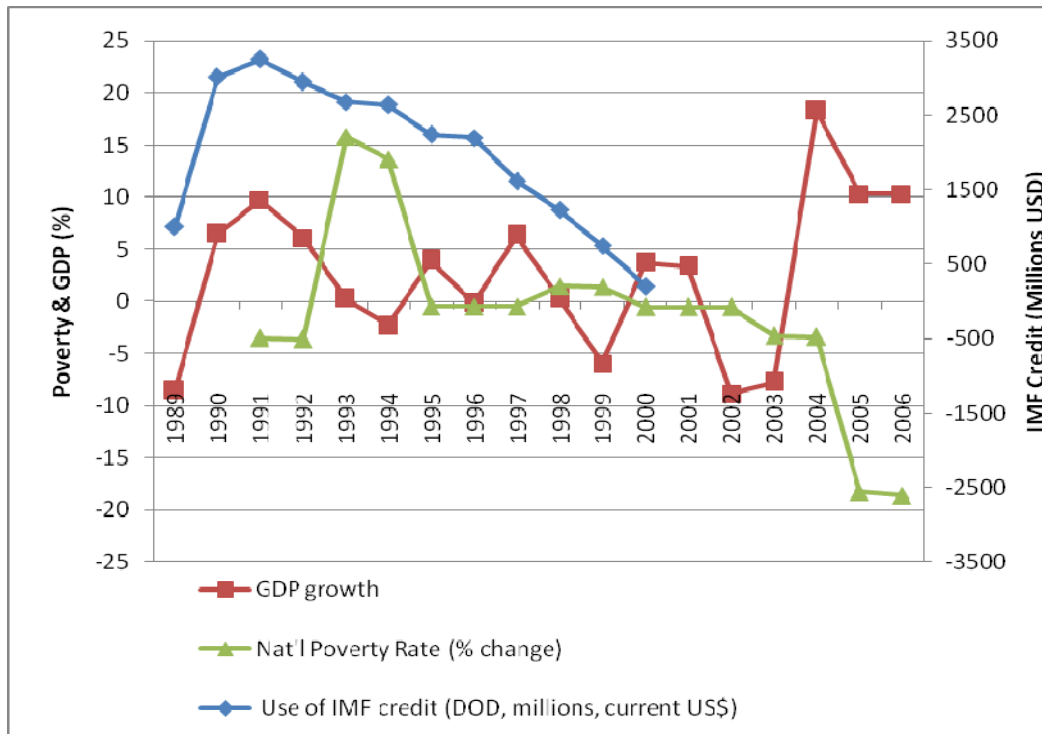
Mexico and the IMF
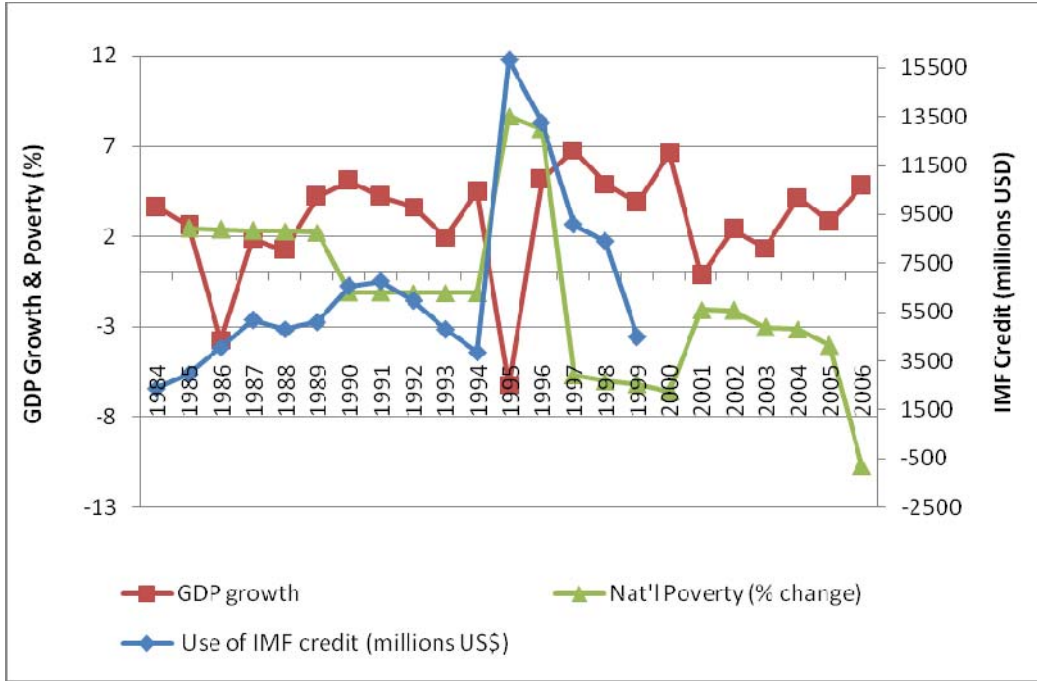
*some avgs. were calculated

Argentina and the IMF

*some avgs. were calculated

74

Venezuela and the IMF

*some avgs. were calculated

Discussion Section

Through the quantitative methodology of collecting time series data for the three countries I was able to find numbers for several variables. Predominately these figures included use of IMF credit, public health expenditure, public education expenditure, national poverty rate, and also Gross Domestic Product Growth. From these three graphs, I found that there is a negative correlation concerning IMF loans, GDP growth, and also the rate of poverty.

In Mexico, I found that in 1984 when International Monetary Fund credit was the lowest, Gross Domestic Product was at its highest. As IMF loans increase, there is a sharp decrease in GDP growth. In addition IMF loans did little to eradicate poverty, as there is no decrease in poverty rates. In 1995, I found that as there was an evident increase in IMF loans, and in turn a steep decrease in GDP growth, as well as in increase in the rate of poverty. This phenomenon occurred after NAFTA which promised economic growth. From this graph we also see that poverty finally decreases, and also GDP growth commences after IMF conditions are discontinued.

In Argentina, I found that in 1991 GDP was at its highest when IMF loans were at their lowest. As loans increased, GDP decreased. In addition, poverty rates were at their highest when IMF loans increased. On the other hand poverty rates decreased, as IMF loans increased. In this graph, I found a constant relationship with the IMF and its loans to the country. Even though there is a constant relationship to the IMF it is not beneficial to the development of the country as GDP growth is the same as it was in 1986 as it is in 2005 onward. We see a dependence on IMF loans, but GDP growth constantly

fluctuating. In 2001 we see that the country experiences an economic crisis, and even though there was a constant relationship with the IMF, the IMF did little to nothing to prevent this crisis.

In Venezuela I found similar effects of IMF loans. As IMF loans increase, poverty is at its highest. As IMF loans are discontinued poverty rates continue to decrease and GDP is at its highest. When IMF loans are discontinued it takes a few years for the country to improve its conditions, and after 2004 I found that the country's growth soared and poverty rates continue to decrease dramatically.
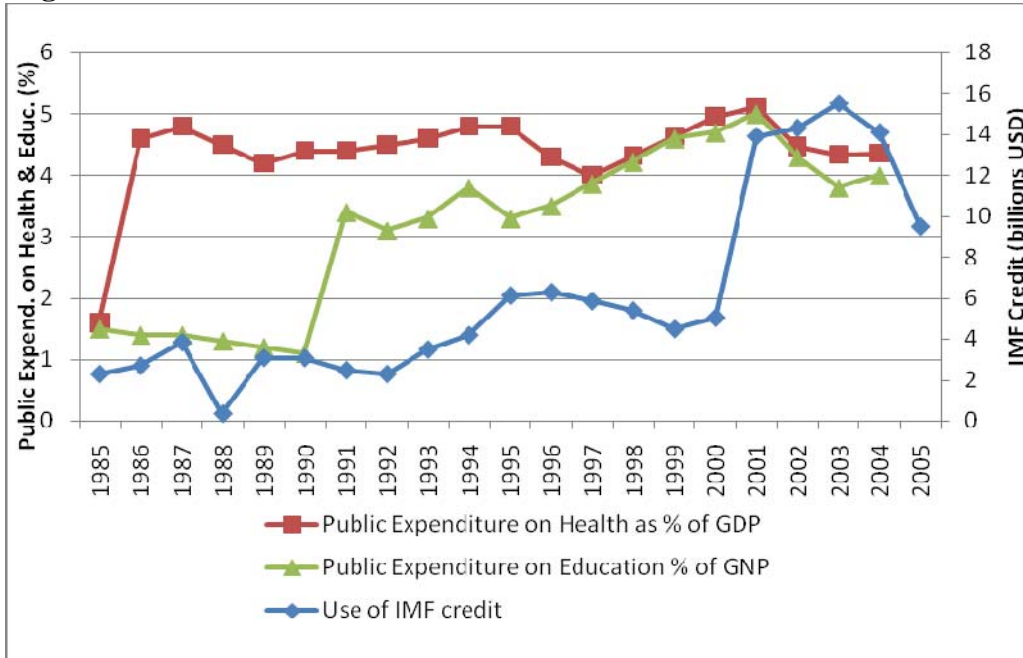
Quantitative Continued
The following graphs analyze the use of IMF credit, Public Expenditure on Health, and Public Expenditure on Education.

Mexico and the IMF
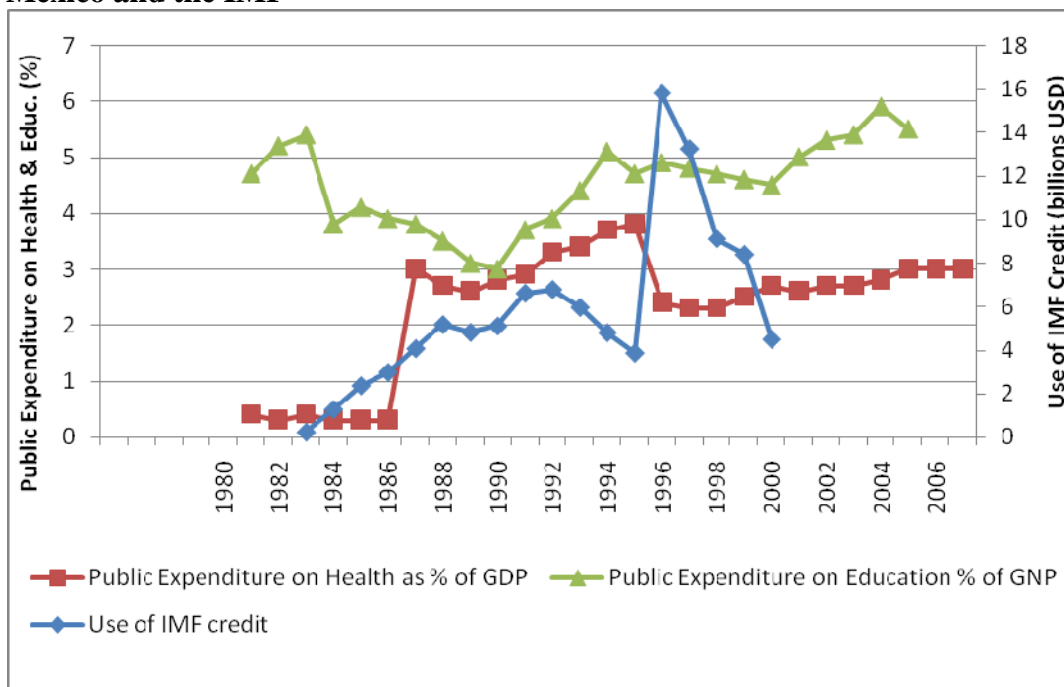
*some avgs. were calculated

Argentina and the IMF

*some avgs. were calculated

Venezuela and the IMF
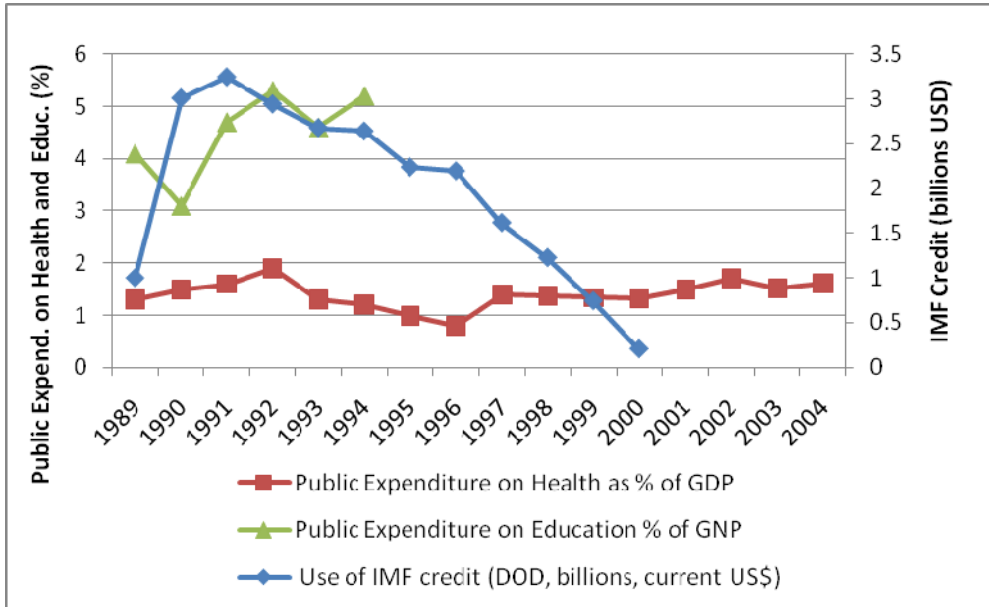
*some avgs. were calculated

Discussion Section

From these three graphs I found that there is a negative correlation between IMF loans and public health expenditure on health as a percentage of Gross Domestic Product, and also public expenditure on Education as a percentage of Gross National Product. In Mexico, I found that as IMF loans increase from 1984 to 1992 public expenditure on

education as a percentage of gross national product decreases. As IMF loans decrease from 1992 to 1994 public expenditure on health and education increases. When IMF loans are at their highest in 1996 there is a sharp decline in public expenditure on health as % of GDP, and also a decline in education expenditure. When IMF loans are discontinued, there is a clear increase in education expenditure, and health expenditure slowly rises. [good findings and good analysis!]

In Argentina, there is a constant relationship with the IMF as shown in the earlier graph. However, IMF loans do little to nothing to improve public expenditure on health as it remains at an average of 4-5% from the years of 1985 through 2004. In 1991 public expenditure on education rises increasingly as IMF loans decrease. As loans decrease in 1999 health and education expenditure continue to rise until 2001 when IMF loans increase remarkably. Soon after, there is a sharp decline in health and education expenditure. In 2003, when IMF loans increase to their highest, health and education expenditure decreases. [yes-

In Venezuela in 1990, IMF loans are at their highest and there is a sharp decrease in public expenditure on education. While loans decrease in 1992 there is an increase in health and education expenditure. In 1994 loans decrease again and education expenditure increases. The latest data do not allow for a more recent analysis of the impact of IMF loans on education expenditures. When IMF loans are severed in 2000, health expenditure steadily rises, although the rise does not appear to be immediate. Nonetheless, as we see with Argentina, it is clear that IMF loans did not result in an increase in education expenditures.

Qualitative

In my qualitative findings I was able to find the differentiating politics within the three countries. Through the North American Free Trade Agreement, and the conservative politics of its leaders throughout the years of 1980- 2006, Mexico has accepted the ideals of the IMF and also the U.S. Through its continuing relationship with the IMF, and being seen as the "poster child for reform", Argentina has displayed what I would refer to as a moderate response to the IMF. Furthermore, the leaders of the country have supported globalization, but argue for reform in the current system of global interconnection. Lastly, in efforts to create an alternative institution to the IMF, Venezuela has demonstrated the idea of regional "globalization" within Latin America as a primary effort before globalization with the entire world in which there is an unequal distribution of power which we see concerning IMF quota and voting power. In the following sections I will further demonstrate the individual politics of these three countries.

The North American Free Trade Agreement has impeded public health care expenditure as the agreement does not seek out for the betterment of the poor but the benefit of the elite and also multinational corporations who support the agreement. The journal article The North American Free Trade Agreement and Public Health at the US-Mexico Border written by Waterman and Stolp seeks to analyze the agreement and its effects on public health care in Mexico. "The argument that we make is that NAFTA has not facilitated the erasing of the constraints that impede collaboration between health workers. Our conclusion is that globalization, as exemplified by NAFTA, benefits not

78

the health of the people, but that of transnational corporations"(Stolp 2004). While free trade has affected those living in utter poverty negatively, policies are consistently encouraged by the current president of the country. The current president Felipe Calderón is affiliated with the National Action Party which is a mostly conservative organization with a tendency towards neoliberal economic ideas. His proposed economic policies are liberal; he supports balanced fiscal policies, flat taxes, lower taxes, and free trade. He also argues for privatization, liberalization, market control of the economy, and political freedom. While many in the country live in poverty and work in sweat shops as encouraged by globalization, free trade continues to be implemented by the country's elite and is also seen as the best approach to effective development.

There are clear benefits for Latin American countries to separate relations with the IMF. Whatever the economics involved, severing relations with the IMF is always good politics, in Latin America in particular (Economist 2008). After Brazil's finance ministry announced that it would repay early its entire debt of $15.5 billion owed to the IMF over the next two years, the government immediately urged Nestor Kirchner, Argentina's president, into an identical declaration. He said his government would repay $9.8 billion to the Fund, before the end of the month. Both governments claimed they would make financial gains from the move. Brazil saved over $900m in interest payments, and Argentina saved $842m (Economist 2008). Through this it is shown that individual countries profit from disentangling from IMF loans and the debt they subsequently cause.

In Venezuela, leaders of several South American nations have signed a founding document to create a new body, the Bank of the South. This institution is proposed as an alternative to multilateral credit organizations such as the International Monetary Fund and World Bank. The idea was first put forward by Venezuelan President Hugo Chavez. "The model we are pursuing is not, I insist, anti-globalization but globalization with a conscience -for human development, equity and democracy; globalization from the bottom up, that doesn't leave the poor behind."
Hugo Chavez (Interview w/ New Perspectives Quarterly.) While Chavez has been mistakenly accused of Anti-Americanism and also Anti-globalization, he argues firstly for a regional globalization that is fairer to underdeveloped countries as they are not given an equal voting power in the current IMF decision making process. Once countries are given the opportunity to trade and cooperate on a regional level there is a greater prospect for development to compete on a global level.

Conclusions

In the quantitative methods of my study I found that IMF loans are correlated with lower GDP growth and higher rates of poverty. In years IMF loans increased, I saw that poverty rates also increased, and GDP growth either declined or remained stagnant.
In the qualitative respect I found three distinct responses to the IMF and globalization varying from a conservative neoliberal approach to one that favored greater economic equality in the international monetary system. Since my research suggests that the processes of the IMF are linked to an extreme imbalance of power, the idea of greater Latin American unification and specifically a Bank of the South as proposed by President

Hugo Chavez seems the most effective approach. I would also hypothesize regional unification across the globe would be most effective.

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Bisphosphonate and Taxane Effects on Osteoblast Proliferation and Differentiation

Genevieve N. Miller, McNair Scholar, The Pennsylvania State University
Erwin A. Vogler, Ph.D.
Professor of Materials Science and Engineering
Departments of Materials Science and Engineering and Bioengineering
The Pennsylvania State University
Andrea M. Mastro, Ph.D.
Professor of Microbiology and Cell Biology
Department of Biochemistry and Molecular Biology
The Pennsylvania State University

ABSTRACT

Breast cancer is the second most commonly diagnosed cancer in women in the United States. Advanced stages of breast cancer frequently metastasize to bone, where it is difficult to diagnose and treat. Current cancer-in-bone therapeutics focus on bisphosphonates to inhibit osteolysis (bone dissolution by osteoclasts) and taxanes to impede cancer cell growth. Effects of these drugs on osteoblasts (bone forming cells) have not been well studied. The purpose of this study is to observe and quantify the effect of a bisphosphonate (zoledronic acid) and a taxane (docetaxel) on osteoblast proliferation and differentiation. Results of this research serve as preliminary data that will guide studies in an advanced three-dimensional bone tissue model.

INTRODUCTION

Breast Cancer in Bone

Breast cancer is among the most commonly diagnosed cancers in the United States. This year alone, approximately 182,460 women in the United States will develop invasive breast cancer, and 40,480 women are expected to die from the disease. The risk of a woman in the United States developing breast cancer in their lifetime is now 1 in 8[1]. Worldwide, breast cancer has reached epidemic proportions[2].

Metastatic breast cancer is the most advanced stage of breast cancer, and the most frequent site of breast cancer metastases is bone. Of the cases of breast cancer diagnosed each year, approximately 25% of those cancers metastasize, with the first site of metastasis located in bone in 46% of cases and in 70% of cases with first relapse. Once cancerous breast cells colonize bone, the cure rate is almost zero[3].

The normal bone environment is in a dynamic equilibrium – the bone undergoes constant remodeling in which osteoclasts resorb bone, whereas osteoblasts deposit bone. When breast

cancer metastasizes to bone, this balance is shifted to abnormally high osteoclastic resorption. Interactions between osteoclasts and breast-cancer cells establish a vicious cycle in which osteolysis and tumor activity both increase. Activation of osteoclasts results in pain, bone fracture, and hypercalcemia[4-6].

An In Vitro Model of Bone

Modeling the bone environment to study cancer colonization of bone is difficult because few cell culture methods simultaneously provide biological relevance and simplicity required for experimental control. The previous lack of a sophisticated model not only has hindered breast cancer metastasis research, but also has hindered the development of therapeutics for bone metastases. Dhurjati et al. recently developed a compartmentalized culture device, hereafter referred to as the bioreactor, that operates on the principle of continuous growth and dialysis[7]. The bioreactor consists of a cell growth chamber separated from a larger medium reservoir by a dialysis membrane. Waste from the growth compartment and nutrients from the medium reservoir are capable of passing through the dialysis membrane, while macromolecules synthesized by the cells as they develop are maintained in the growth chamber. The bioreactor design creates an extremely stable cellular environment that allows for the growth of three-dimensional tissue for an extended period of time. This cell-culture system allowed development of a three-dimensional multiple-cell layer of osteoblastic tissue over 10 months of continuous culture. Krishnan et al. showed that this three-dimensional tissue was a useful surrogate for studies of cancer in bone[8].

Cancer in Bone Therapy

This research extends the bioreactor model by introducing therapeutic drugs to the system. Two drug families are currently used in the treatment of bone metastases – bisphosphonates to regulate osteoclast activity and taxanes to attack cancer cells. The effects of these drugs on bisphosphonates have not been well studied.

Bisphosphonates are synthetic analogues of inorganic pyrophosphate, in which the oxygen atom connecting the two phosphates is replaced by a carbon atom. This stabilizes the molecule from biological degradation. Nitrogen-containing bisphosphonates have recently proven to be the most aggressive in targeting bone metastases. Bisphosphonates bind strongly to bone mineral, particularly in areas of increased bone activity. As bone resorption occurs, osteoclasts internalize bisphosphonates. Once internalized, the bisphosphonates inhibit an enzyme that contributes to osteoclast function and survival. Recent studies have suggested that bisphosphonates may also have antitumor effects. During bone resorption, growth factors are released that stimulate cancer cell activity; therefore decreased osteoclast activity would have negative effects on cancer cells as well. Bisphosphonates decrease cancer cell proliferation and induce apoptosis[9-13].

Taxanes are widely used chemotherapeutic agents. Taxanes are microtubule interfering agents that bind to β tubulin, causing abnormal assembly of microtubules and preventing disassembly. This arrests the cell cycle in the G_2M phase and induces apoptosis. Taxanes also cause programmed cell death by inducing phosphorylation of Bcl-2, an anti-apoptotic protein[14-15].

Recent work has suggested that the most effective therapy for metastatic breast cancer to bone is combinatorial therapy with a bisphosphonate and a taxane. Bisphosphonates have been shown to enhance the antitumor effects of taxanes *in vitro* on cancer cell invasion, adhesion, and apoptosis[16-17].

The purpose of this research was to assess the effects of a bisphosphonate (zoledronic acid) and taxane (docetaxel) on osteoblast proliferation and differentiation. The goal was to determine an appropriate concentration for use in the bioreactor model. Low concentrations (0.05-0.50 μM) of zoledronic acid enhanced both osteoblast proliferation and differentiation, while high concentrations of docetaxel (10.0 μM) had positive effects on osteoblast differentiation.

MATERIALS AND METHODS

Cells and Cell Culture

Osteoblast Proliferation

Murine calvaria pre-osteoblast (MC3T3-E1) cells were plated at 1×10^4 cells/cm^2 in a 24-well plate and grown in alpha minimum essential medium (α-MEM) supplemented with 10% heat-inactivated fetal bovine serum (FBS) and 1% penicillin-streptomycin, hereafter referred to as growth medium. Cultures were incubated at 37°C. After 24 hours, zoledronic acid was added to the growth medium in 0.05, 0.5 and 5 μM concentrations. Medium was changed after 24 hours to allow for acute exposure (pulse dose) and chronic exposure (chronic dose).

Osteoblast Differentiation

MC3T3-E1 cells were plated at 1×10^4 cells/cm^2 in a 24-well plate and grown in α-MEM supplemented with 10% heat-inactivated FBS, 1% penicillin-streptomycin, 10mM β-glycerophosphate and 50 μg/mL ascorbic acid, hereafter referred to as differentiation medium. Cells were allowed to differentiate for 17 days prior to the addition of zoledronic acid in 0.05, 0.5 and 5.0 μM concentrations or docetaxel in 0.1, 1.0 and 10.0 μM concentrations. After 24 hours, the supernatant was collected for cytokine assays and a media change was performed to allow for acute and chronic dosing. Medium was collected and replenished again after three days.

Zoledronic Acid and Docetaxel

A 5 μM stock solution of zoledronic acid was prepared in 0.1N sodium hydroxide. The stock solution was diluted with growth medium and differentiation medium for measures of cell proliferation and differentiation, respectively. A 10 μM stock solution of docetaxel was prepared in 100% ethanol and diluted with differentiation medium.

Assessment of Cell Proliferation

84

Four day osteoblasts grown in varying concentrations of zoledronic acid were rinsed twice with phosphate buffered saline (PBS) and detached with three rinses of 0.002% pronase in PBS. Upon detachment, the pronase was neutralized with growth medium. The cell suspension was diluted with 0.4% trypan blue dye and both viable and apoptotic cells were counted with a hemocytometer.

Differentiated osteoblasts grown in varying concentrations of zoledronic acid and docetaxel were also counted with a hemocytometer and trypan blue stain. Cells were initially rinsed twice with PBS and detached with three rinses of 0.002% pronase in PBS. The differentiated cells detached as an aggregate accumulated in the collagen matrix. In an attempt to further detach the osteoblasts from the collagen matrix, the pronase solution was neutralized with growth medium and then placed in a centrifuge. The solution was removed and replaced with accutase.

Assessment of Cell Differentiation – Alkaline Phosphatase

Differentiated osteoblasts were stained for alkaline phosphatase (ALP) activity. Cells were rinsed once with PBS and then fixed for 10 minutes with 10% formaldehyde. Cells were then rinsed three times for five minutes each with PBS. The cells were stained with an ALP stain consisting of pre-warmed dH_2O, 0.2M Tris, napthol and Fast Blue RR Salt and incubated at 37°C for 30 minutes. They were then rinsed three times for five minutes each with dH_2O and the dish was set to dry. The cell culture dish was then scanned into a computer. The stain intensity was quantified using ImageQuant software.

MCP-1 and IL-6 Expression

MCP-1 and IL-6 were quantified using a sandwich ELISA. Flat-bottom 96-well plates were coated with antibody at 0.4 µg/ml for MCP-1 and 2 µg/ml for IL-6. Plates were incubated overnight at 4°C. The plates were washed four times with PBS with 0.05% Tween 20 and blocked for 2 hours with PBS and 1% BSA. After three washes, samples and standards were added and incubated overnight at 4°C. The plates were then washed four times and incubated with detection antibody for 2 hours at room temperature. The plates were washed 6 times and incubated with NeutrAvidin horseradish peroxidase conjugate for 30 minutes at room temperature. The plates were washed 8 times and then incubated with ABTS peroxidase substrate at room temperature for 90 minutes. Plates were read at 405 nm in an ELISA reader.

RESULTS

Osteoblast Proliferation

Drug effects on osteoblast proliferation was assessed by means of cell counting and a trypan blue stain. Low concentration zoledronic acid (0.05 µM) enhanced osteoblast growth. As zoledronic acid concentration increased, cell growth declined. Results were the same for both acute and chronic exposures (Fig. 1).
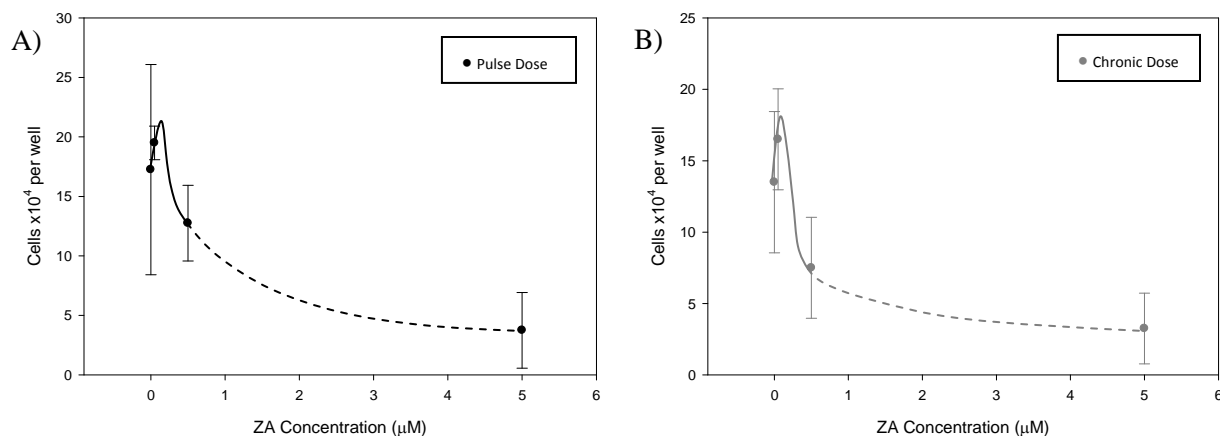
FIGURE 1. Effect of zoledronic acid (ZA) on osteoblast proliferation. Osteoblasts were plated at 1×10^4 cells/cm^2 and ZA was added in concentrations of 0.00, 0.05, 0.50 and 5.00 μM. After 24 hours, medium was removed and replaced according to a dosing regimen. Wells designated for acute exposure (A) were replenished with osteoblast growth medium, while those for chronic exposure (B) received another drug dose. Proliferation was assessed with a trypan blue stain. Lines are guides to the eye.
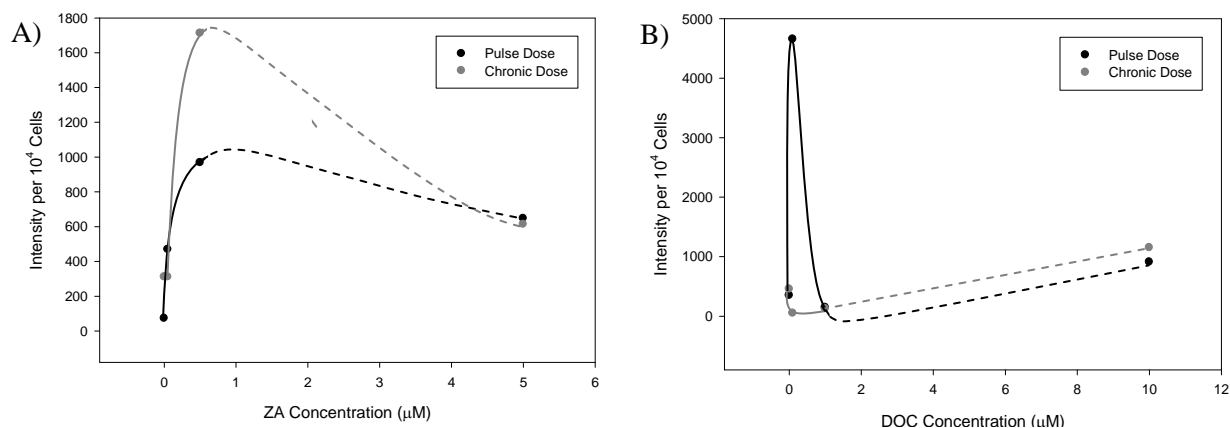

FIGURE 2. Drug effects on alkaline phosphatase production. Osteoblasts were plated at 1×10^4 cells/cm^2 and grown in differentiation medium for two weeks. Cells were treated with either zoledronic acid (ZA) or docetaxel (DOC). ZA (A) or DOC (B) was added in low, medium, and high concentrations (ZA – 0.00, 0.05, 0.50 and 5.00 μM; DOC – 0.00, 0.10, 1.00 and 10.00 μM). After 24 hours, medium was removed and replaced according to a dosing regimen. Wells designated for acute exposure were replenished with osteoblast differentiation medium, while drug doses were added to wells for chronic exposure. Cells were stained for alkaline phosphatase. The intensity of the stain was quantified using ImageQuant software, and intensity was normalized to viable cell number (cell counts obtained using trypan blue stain). Lines are guides to the eye.

Osteoblast Differentiation

Drug effects on osteoblast differentiation were assessed by measuring alkaline phosphatase production. Alkaline phosphatase (ALP) production increased with low and medium (0.05 and 0.50 μM, respectively) zoledronic acid concentrations, while ALP production declined at the higher concentration. Chronic exposure to zoledronic acid caused a more dramatic rise in ALP than the acute exposure. Docetaxel treated cells showed different responses to pulse and chronic

dosing. Acute exposure to docetaxel resulted in a sharp increase in ALP production for low concentration docetaxel (0.1 µM), followed by a rapid decrease to the medium concentration (1.0 µM) and a slight increase with the higher concentration. Chronic exposure to docetaxel produced an immediate decline in ALP production followed by a slight increase with concentration (Fig. 2).

Osteoblast Inflammatory Response

Drugs effects on MCP-1 and IL-6 expression were analyzed to determine whether either drug elicited an inflammatory response from the osteoblasts. Acute exposure of zoledronic acid decreased expression of MCP-1 as a function of concentration. Chronic exposure, however, increased MCP-1 expression through low and medium concentrations of zoledronic acid (0.05 and 0.50 µM, respectively), followed by a decline in MCP-1 expression (Fig. 3). Most zoledronic acid treated cells produced IL-6 below the level of detection, therefore the data were inconclusive (Table 1).

Both pulse and chronic doses of docetaxel elicited similar osteoblast responses. Low concentration docetaxel (0.1 µM) increased MCP-1 expression, followed by a decline through medium and high concentrations of the drug (Fig. 3). IL-6 concentrations were below the level of detection in both dosing methods. After 24 hours exposure to docetaxel, IL-6 expression was detectable, with IL-6 concentrations decreasing with increasing docetaxel concentration (Table 2).
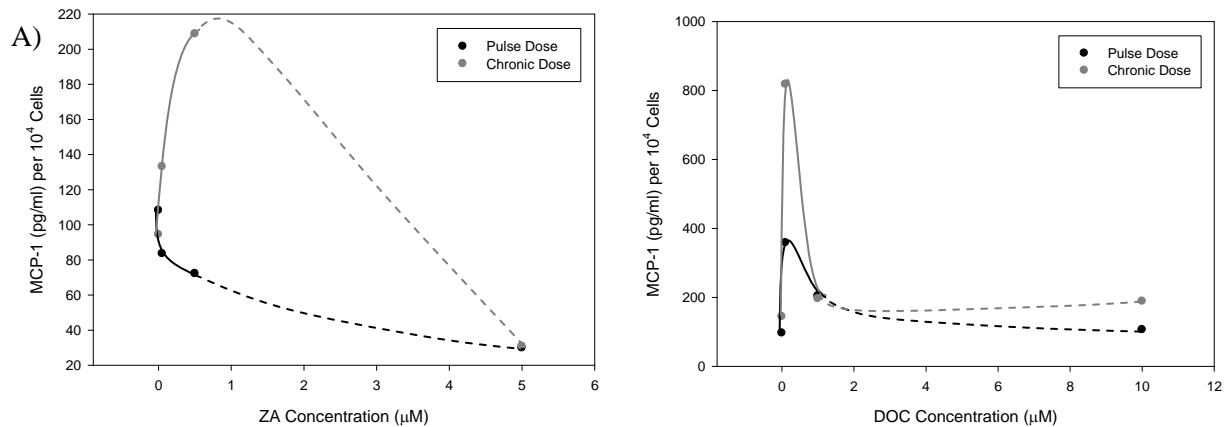
FIGURE 3. Drug effects on MCP-1 expression. Osteoblasts were plated at 1×10^4 cells/cm^2 and grown in differentiation medium for two weeks. Cells were treated with either zoledronic acid (ZA) or docetaxel (DOC). ZA (A) or DOC (B) was added in low, medium, and high concentrations (ZA – 0.00, 0.05, 0.50 and 5.00 µM; DOC – 0.00, 0.10, 1.00 and 10.00 µM). After 24 hours, medium was removed and replaced according to a dosing regimen. Supernatant was collected after an additional 3 days of culture. Supernatant was assayed for MCP-1 using a sandwich ELISA. MCP-1 concentration was normalized to viable cell number (cell counts obtained using trypan blue stain). Lines are guides to the eye.

TABLE 1. Effects of zoledronic acid (ZA) on IL-6 expression.			
IL-6 Concentration (pg/ml)			
ZA Concentration	24 Hours	Pulse Dose	Chronic Dose
Control - 0	54.0	*	*
Low - 0.05	*	*	22.0
Medium - 0.5	*	*	*
High - 5.0	26.0	18.0	*

Osteoblasts were plated at $1x10^4$ cells/cm^2 and grown in differentiation medium for two weeks. Cells were treated with ZA in control, low, medium and high concentrations (0.00, 0.05, 0.50 and 5.00 μM, respectively). After 24 hours, supernatant was collected and replaced according to a dosing regimen. Supernatant was collected after an additional 3 days of culture. Supernatant was assayed for IL-6 using a sandwich ELISA.

TABLE 2. Effects of docetaxel (DOC) on IL-6 expression.			
IL-6 Concentration (pg/ml)			
DOC Concentration	24 Hours	Pulse Dose	Chronic Dose
Control - 0	139.0	*	*
Low - 0.1	47.0	*	*
Medium - 1.0	84.0	*	*
High - 10.0	91.0	*	*

Osteoblasts were plated at $1x10^4$ cells/cm^2 and grown in differentiation medium for two weeks. Cells were treated with DOC in control, low, medium and high concentrations (0.00, 0.10, 1.00 and 10.00 μM, respectively). After 24 hours, supernatant was collected and replaced according to a dosing regimen. Supernatant was collected after an additional 3 days of culture. Supernatant was assayed for IL-6 using a sandwich ELISA.

DISCUSSION AND FUTURE WORK

The bisphosphonate zoledronic acid and the taxane docetaxel have pronounced effects on osteoblast proliferation and differentiation. Low concentrations of zoledronic acid enhanced both osteoblast proliferation and differentiation. However, low concentrations also elicit the most pronounced inflammatory response. High concentrations of docetaxel incur the lowest inflammatory response and have the most positive effects on osteoblast differentiation. From these observations, zoledronic acid at 0.05 μM and docetaxel at 10 μM are candidates for use in the bioreactor model. Choice of ideal concentrations will depend on the effect on breast-cancer cells from future work. Future experiments include assessing the effects of these drugs on breast-cancer cells and evaluating combinatorial therapy in standard tissue culture.

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The Predictive Validity of a Screening Measure for identifying individuals with Personality Disorders

Jennifer Mulcahy-Avery, McNair Scholar, The Pennsylvania State University

Faculty Research Advisor: Dr. Kenneth N. Levy
Assistant Professor of Psychology
Department of Psychology
College of Liberal Arts
The Pennsylvania State University

Abstract

We examined the predictive validity of a personality disorders screening instrument, the International Personality Disorder Screener (IPDE-S). One thousand and fourteen undergraduates at a large Northeastern urban university completed the IPDE-S as part of a larger study (Posner et al., 2002). A subset of 66 individuals were interviewed with the International Personality Disorder Examination (IPDE), a semi-structured interview for assessment for the DSM, designed by NIMH and WHO to assess DSM-IV and ICD (International Classification Diagnosis). The predictive validity of the IPDE-S for identifying individuals with personality disorders on the IPDE was determined using the conditional probabilities of positive predictive power, negative predictive power, sensitivity, and specificity. Findings indicate the screener had high sensitivity but low specificity.

Introduction

Recent research suggests that personality disorders (PD's) are highly prevalent, frequently comorbid with other psychiatric disorders and negatively affect the outcome of otherwise efficacious treatment PD's are even highly prevalent in non-clinical epidemiological samples (Grant, et al., 2004; Skodol, et al., 2002). In college samples, PD's have shown to negatively impact students psychosocial and academic functioning (Bagge et al., 2004; Lenzenweger; 1999). Given these facts, it has become increasingly important to be able to identify individuals suffering from personality disorders. In response, a number of clinical researchers have developed brief screening measures to identify individuals who may be suffering from PDs (Loranger, 1994; Zanarini et al. 2003). These screening measures assess a variety of PDs, showing different levels of sensitivity, specificity, positive predictive power and negative predictive power.

Zanarini et al. (2003) developed a screening measure for borderline personality disorder (BPD). The screener consisted of 10 true/false questions that assessed criteria based on the DIPD-IV (diagnostic interview for the DSM-IV personality disorders) module. The study looked for high sensitivity and specificity rates for their screener. At the optimal cutoff score of 7, the screener yielded a sensitivity of .81 and .85, showing that the screener was able to correctly identify all those who met diagnostic criteria for BPD on the interview, as well as correctly identifying all the individuals who did not meet criteria for BPD on the interview. The adequate levels of both sensitivity and

specificity make the screener a viable tool in indentifying which individuals should be evaluated more thoroughly for the presence BPD.

In another study, (Dalrymple and Zimmerman, 2008) screened individuals for the prevalence of social fears and a lifetime history of SAD (social anxiety disorder) using the screening question in the SAD module of the SCID I (SCID; First, Spitzer, Williams, & Gibbon, 1997). They measured the screener using the four conditional probabilities of sensitivity, specificity, positive predictive power and negative predictive power. The researchers modified the screener by adding a list of 13 social fears. Subjects were asked the first question "Was there ever anything that you have been afraid to do or felt uncomfortable doing in front of other people, like speaking, eating, or writing?" If the question was answered affirmatively, the additional 13 questions were assessed. The results showed that with the additional 13 questions, the sensitivity was extremely high at 100%, specificity moderate at 66.4%, positive predictive power at 58.2 % and negative predictive power at 100%. With the social fears questions, the screener produced a great ability to correctly identify all those who met criteria for SAD along with being able to moderately identify all those who do not meet criteria for SAD.

A more ambitious study (Morse & Pilkonis, 2007) examined three different screeners for PD's including the Inventory of personal problems personality disorder scale (IIP-PD; Horowitz, Rosenberg, Ureno & Villaseno, 1988), the Self-Directedness Scale: Temperament and Character Inventory (TCI-SD; Cloninger et al., 1994) and the Iowa Personality Disorder Screen (IPDS; Langbehn et al., 1999). The sample consisted of psychiatric, and non-psychiatric and community populations. After screeners were completed, the participants completed a semi-structured interview, the Interpersonal Relations Assessment (IRA; Heape, Pilkonis, Lambert & Proietti, 1989) and a structured interview, the Structured Interview for DSM-IV personality (SID IV; Pfohl, Blum, & Zimmerman, 1997). The results of the conditional probabilities for the three screening measures showed that in the psychiatric population, the screeners were moderately able to correctly identify all those who met criteria for a PD on semi-structured and structured interviews. In the non-psychiatric sample, the screeners had a more varied mix, showing lower levels of sensitivity and specificity. The goal of the study was to see if using more than one screener would increase validity. However, it was found that no one screener was superior to any other.

Along with the various measures mentioned previously, there is a screener to accompany the International Personality Disorder Examination (IPDE), the IPDE-S. In an initial validation study, Lenzenweger and colleagues, (Lenzenweger et al., 1997) used a two-stage application process to determine the efficacy of the IPDE-S and the IPDE interview. The researchers used the IPDE-S to determine how well it could be used as a screener for PDs on the IPDE interview. Their results found that the screener had high sensitivity at .81, moderate specificity at .61, extremely high negative predictive power at .98 and low positive predictive power at .21. The Lenzenweger study represents an initial first step in validating the IPDE-S; however because the sample in the study consisted of a group of homogenous upper class elite students, little is known about the predictive validity of the measure in a more racially, ethnically and economically diverse samples.

In the present study, I examined the predictive validity of the IPDE screener in a

92

diverse, working-class sample of students using the four conditional probabilities, specificity, sensitivity and positive and negative predictive power. Specificity is the probability that, given an absence of a PD on the interview, the threshold for a PD was not met on the screener. Sensitivity is the probability that, given the presence of a positive diagnosis of a PD on the interview, the threshold was met for a probable PD on the screener. Positive predictive power is the probability of receiving a probable diagnosis of a PD on the interview, given that there was a positive diagnosis of a PD on the screener. Negative predictive power is the probability of not receiving a PD diagnosis on the interview given that there was a negative diagnosis of a PD on the screener. Examining the predictive validity of the IPDE-S on a racially, ethnically and economically diverse sample allows for the testing of the generalizability of the Lenzenweger finding and provides further validity for the IPDE-S.

Method

Participants

Eleven hundred and fourteen undergraduates at a large urban Northeastern University completed the International Personality Disorder Examination Screener (IPDE-S) as part of a larger study (Posner et al., 2002). A subset of 66 of these individuals completed the interview for the International Personality Disorder Examination (IPDE). Seven hundred and twenty two (71.1%) of participants were women, 349 (34.3%) were Caucasian, 206 (20.3%) were of African American descent, 211 (20.8%) were of Asian descent, and 250 (24.6%) were Latino/a. Five hundred and twenty-seven (51.9%) students were employed. Complete Demographic characteristics for the subgroups can be seen in table 1.

Measures

International Personality Disorder Examination Screener (IPDE-S) (Loranger, 1991).

The screener for the IPDE-S is a 77 item True/False paper and pencil measure designed to assess for the presence of pathological personality traits. The IPDE-S screens for the ten DSM-IV personality disorders; cluster A (paranoid, schizoid, schizotypal), cluster B (antisocial, borderline, histrionic and narcissism), and cluster C (avoidant, dependent, obsessive-compulsive). The screener focuses on six different areas of personality and behavior. These areas are work, self, interpersonal relations, affects, reality testing, and impulse control. The questions on the screener are scored based on the sum of endorsed items.

International Personality Disorder Examination (Loranger, 1994).

International Personality Disorder Examination (IPDE, Loranger, Sartorius, Andreoli, & Berger, 1994). The IPDE is a semi-structured diagnostic interview for diagnosing personality disorders. It consists of 99 items arranged in six categories (e.g., Self or Work), along with a detailed scoring manual (Loranger et al., 1994). Each item assesses part or all of a *DSM-IV* personality-disorder criterion and is rated on a three-

point scale: 0 = *absent or normal,* 1 = *exaggerated or accentuated,* 2 = *meets criteria or pathological.* Items consist of one or several primary questions and follow-up questions. All positive responses are followed by requests for examples. After the provided questions are exhausted, the clinical interviewer is free to ask additional questions until he or she is able to score the item. The IPDE generates probable (subthreshold number of *DSM-IV* criteria met) and definite diagnoses for each of the *DSM-IV* diagnoses. It also generates dimensional scores for each diagnosis by adding the ratings on all the criteria composing a diagnosis.

Data Analysis

   Chi-square analyses were used to compare those who were above threshold for a PD on the IPDE-S and those meeting criteria for a PD on the IPDE. Based on the chi-square analyses the conditional probabilities of positive predictive power, negative predictive power, sensitivity and specificity were calculated.

Results

Diagnosis

   As shown in table 2, nine (13.6%) of the 66 interviewed participants met criteria for either a probable or definite diagnosis of a personality disorder on the IPDE interview. These nine individuals had a total of 18 PD's. Six participants met criteria for a definite diagnosis, with those PD's being- borderline, histrionic, dependent and PDNOS. Additionally, there were 7 participants that met criteria for a probable diagnosis; with those PD's being paranoid, borderline, histrionic, narcissistic, and PDNOS. Due to comorbidity of PD's, participants often had two or three diagnoses, resulting in various combinations of definite and probable scores.

Conditional Probabilities

   As shown in table 3, four sets of conditional probabilities-positive predictive power, negative predictive power, sensitivity and specificity were calculated for the diagnosis of a PD.

   Sensitivity was extremely high (100%) with all nine participants who met criteria for either a probable or definite PD also having met threshold for a PD on the IPDE screener. However, specificity was extremely low (5.9%). Similarly, negative predictive power was extremely high (100%) while positive predictive power was low (15.8%). These probabilities were assessed based on the IPDE-S manual suggested cutoff score of 3 (Loranger, 1991). Cutoff scores were later raised, to see if the probabilities would improve. A cutoff score of 4 also yielded extremely high sensitivity (100%), but improved the specificity slightly (17.6%). Negative predictive power (100%) and positive predictive power (17.6%) were similar to a cutoff score of 3. A cutoff score of 5 also yielded extremely high sensitivity (100%), and a moderate level of specificity (37.3%). Negative predictive power was extremely high (100%) and positive predictive power was low (22.0%), but slightly improved. A cutoff score of 6 yielded moderate sensitivity (55.6%), but much improved specificity (64.7%). Negative predictive power remained high (89.2%) but positive predictive power was still low (21.7%). The Kappa statistics for the cutoff scores were .018 for a cutoff score of 3, .060 for a cutoff score of 4, .151 for a cutoff score of 5 and .124 for a cutoff score of 6.

94

Discussion

The IPDE-S has shown adequate predictive validity in a homogenous, primarily Caucasian economically advantaged and elite student sample. However, replications of that finding are needed and questions remain regarding the generalizability of previous studies to more diverse groups. Therefore, the IPDE-S was examined to test its predictive validity in a diverse sample.

The IPDE-S showed excellent sensitivity with cutoff scored of 3, 4 and 5 correctly identifying all those who were diagnosed with a PD based on the IPDE interview. However, its specificity was very low, (especially for cutoff scores of 3, 4 and 5) and thus misidentified large numbers of individuals who did not meet criteria for a PD based on the IPDE interview. Although specificity was better with a 6 criteria cutoff, it was not adequate and additionally the sensitivity decreased to an inadequate level. A cutoff score of 5 however, yielded the best overall results. Likewise, the strongest kappa value is for a cutoff score of 5 at .151, indicating the screener and the interview matched best at this score.

Results from similar studies (Lenzenweger et al., 1997) show that efforts to reduce false- positive rates by increasing the threshold resulted in higher false-negative rates. The findings of the current study suggest that a higher cutoff score than that indicated in the IPDE-S manual might be preferable. A cutoff score of 5 might be useful in a two-stage process to identify those likely to have a PD, but it is unlikely that any cutoff score is sufficient for clinical use. Other studies have found weak conditional probabilities with other PD screening measures (Morse et al., 2007).

Strengths of the current study include a diverse urban sample. Previous studies, (Lenzenweger, et al., 1997; Lenzenweger 1999; Bragge et al., 2004) were conducted using homogenous samples. One important limitation is the relatively low number of individuals meeting criteria for a PD, thus these results need to be replicated in a larger sample.

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Table 1.

Participant Demographic Characteristics

	Screened Participants (N=1014)	Interviewed (N=66)	Diagnosed with PD (N=9)
Mean Age (SD)	20.03 (4.00)	20.8 (4.89)	19.22 (1.20)
Female (%)	722 (71.1)	54 (81.8)	6 (66.6)
Ethnicity (%)			
Caucasian	349 (34.3)	31 (46.9)	4 (44.4)
African Descent	206 (20.3)	8 (12.1)	1 (11.1)
Asian	211 (20.8)	9 (13.6)	1 (11.1)
Latino/a	250 (24.6)	11 (16.6)	2 (22.2)
Other		1 (1.5)	1 (11.1)
Employed (%)			
Yes	527 (51.9)	29 (43.9)	5 (55.5)
Education Level of Father (%)			
Less than Jr. High School	47 (4.6)	4 (6.3)	1 (11.1)
Junior High School	55 (5.4)	1 (1.6)	
Partial High School	96 (9.4)	4 (6.3)	1 (11.1)
High School Graduate	236 (23.2)	20 (31.7)	4 (44.4)
GED	27 (2.7)	1 (1.6)	
Partial 2 yr. college	49 (4.8)		
Partial 4 yr. college	56 (5.5)		
Technical School	57 (5.6)	4 (6.3)	
Associate Degree	35 (3.4)	1 (1.6)	
Standard College (BA, BS, AB)	173 (17.0)	8 (12.7)	3 (33.3)
Masters Level (MA, MS, MSW, MPH)	78 (7.7)	9 (14.3)	

Doctoral Degree (PhD, MD, JD)	40 (3.9)	2 (3.2)	
Education Level of Mother (%)			
Less than Jr. High School	68 (6.7)	5 (7.9)	
Junior High School	50 (4.9)	1 (1.6)	
Partial High School	91 (9.0)	6 (9.5)	
High School Graduate	261 (25.7)	16 (25.4)	3 (33.3)
GED	25 (2.5)	2 (3.2)	2 (22.2)
Partial 2-yr college	72 (7.1)	1 (1.6)	
Partial 4 yr. college	59 (5.8)	2 (3.2)	1 (11.1)
Technical School	32 (3.1)	1 (1.6)	
Associate Degree	48 (4.7)	4 (6.3)	
Standard College (BA, BS, AB)	165 (16.2)	8 (12.7)	2 (22.2)
Masters Level (MA, MS, MBA MPH)	95 (9.4)	8 (12.7)	1 (11.1)
Doctoral Level (PhD, MD, JD)	16 (1.6)	1 (1.6)	

Note: Data on gender were missing for 117. Data on employment were missing for 198. Data on education were missing for 132 participants. Of the 66 interview participants, data were missing for age on 6 participants, for ethnicity on 6 participants, for employment on 12 participants and for education of parents on 12 participants.

Table 2

Prevalence of a Personality Disorder on the IPDE.

Interviewed Subgroup N=66	Definite N (%)	Probable N (%)	Total N (%)
Paranoid	0 (0.0)	2 (28.5)	2 (33.3)
Schizoid	0 (0.0)	0 (0.0)	0 (0.0)
Schizotypal	0 (0.0)	0 (0.0)	0 (0.0)
Antisocial	0 (0.0)	0 (0.0)	0 (0.0)
Borderline	1 (16.6)	3 (42.8)	4 (44.4)
Histrionic	2 (33.3)	3 (42.8)	5 (55.5)
Narcissistic	0 (0.0)	1 (14.2)	1 (11.1)
Dependent	2 (33.3)	0 (0.0)	2 (22.2)
Ob-Compulsive	0 (0.0)	0 (0.0)	0 (0.0)
PDNOS	3 (2.0)	1 (14.2)	4 (44.4)
AnyPD	6 (9.1)	7 (10.6)	9 (13.6)

Note: Due to comorbidity, the number of PD's is greater than the number of subjects.

Table 3

Conditional Probabilities for the IPDE-S Cutoff Scores.

	3 Criterion	4 Criterion	5 Criterion	6 Criterion
PPP	15.8%	17.6%	22.0%	21.7%
NPP	100%	100%	100%	89.2%
Sensitivity	100%	100%	100%	55.6%
Specificity	5.0%	17.6%	37.3%	64.7%
True Pos.	9	7.6	9	5
False Pos.	48	43.4	32	18
True Neg.	3	7.6	19	33
False Neg.	0	1.4	0	4
Kappa	.018	.060	.151	.124

Parent Differentiation of Self and Cognitive Competence in Low-Income, Rural Families (At-Risk Youth)

Marquita L. Stokes, McNair Scholar, The Pennsylvania State University

Faculty Research Advisor: Dr. Elizabeth A. Skowron
Associate Professor of Counseling Psychology
Department of Counselor Education, Counseling Psychology, and Rehabilitation Services
College of Education
The Pennsylvania State University

In this project, the relationship between parent differentiation of self and child cognitive competence will be examined in a sample of 60 low-income, rural families. Specifically, we hypothesized that greater differentiation of self among mothers will predict higher cognitive achievement in children as measured by the Stanford-Binet-5. Results will be presented and implications for counseling will be discussed.

Many studies suggest that emotional characteristics of family interactions influence children's cognitive abilities. Particularly, research has shown that parent personality and parenting competence predicts both children's cognitive competence and their socio-emotional functioning (Blair, 2002). This relationship may be due to children's initial reliance on caregivers for social and intellectual stimulation as well as for their physical needs (Bowlby, 1969; Cowan, 1982; Sroufe, 1979; Estrada, Arsenio, Hess, & Holloway, 1987). Research supports the idea that strong behavioral regulation is associated with higher levels of academic achievement in elementary school. It has been found that children with higher behavioral regulation achieved at significantly higher levels in emergent literacy, vocabulary, and math tasks (McClelland, Cameron, Connor, Farris, Jewkes, & Morrison, 2007). There is less work examining this relationship before the onset of formal education (i.e., kindergarten). Studies of attachment have indicated that parent-child affective relationships influence children's cognitive and social competence during the preschool years. Children who are securely attached as infants subsequently approach cognitive tasks with more curiosity, persistence, enthusiasm, and less frustration than less securely attached infants (Bretherton, 1985). There is also increasing evidence that young children's attention, working memory, and inhibitory control are each important for school performance and adjustment (Alexander, Entwisle, & Dauber, 1993; Blair, 2002; Bull & Scerif, 2001; McClelland, Acock, & Morrison, 2006; National Institute of Child Health & Human Development [NICHD] Early Child Care Research Network, 2003). The NICHD Early Child Care Research Network (2003) found that children's attention in preschool predicted their reading and math achievement at 54 months of age (McClelland et al., 2007)

Moreover, low-socioeconomic status (SES) kindergarteners showed poorer attention while performing a difficult computer task compared with students from more affluent homes, and lower attention predicted lower achievement skills in the low-SES

group (Howse, Lange, Farran, & Boyles, 2003). In rural families, a lack of adequate financial resources was associated with more depressive symptoms and lower self-esteem among mothers. Self-esteem was linked with family routines and mother-child relationship quality. Furthermore, the link between mother-child relationship quality and child academic and psychosocial adjustment was mediated by the development of child self-regulation (Brody & Flor, 1997). High levels of motivation and self-regulation were significantly associated with academic achievement independent of measured intelligence (Gottfried, 1990; Skinner, Zimmer-Gembeck, & Connell, 1998; Blair, 2002).

Likewise, research shows that protective factors in the family system and the individual child each play a role in decreasing the growth of problem behaviors and supporting competence (Cicchetti, Rappaport, Sandler, & Weissberg, 2000; Durlak & Wells, 1997; Garmezy, 1991; Masten & Coatsworth, 1998; Weissberg, Kumpfer, & Seligman, 2003). Specifically, a parent's ability to manage their own emotions is thought to influence their child's ability to remain calm under stress, to focus their attention and apply the mental processes necessary for learning. When affect can assist and support processes of executive function, it promotes self-regulation and optimal functioning (Campos & Barrett, 1984). That is, under optimal conditions, affective experience does not compete with or interfere with the cognitive demands of a particular setting (Blair, 2002). This study will focus on testing the relationship between one parent characteristic thought to be central to parenting competence, specifically parent differentiation of self (Bowen, 1978), for predicting cognitive competence among at-risk pre-school children.

Bowen theory is considered one of the most comprehensive explanations of individual functioning from a family systems perspective. Of the six major concepts of Bowen family systems theory, differentiation of self arises as the most central component (1978; Kerr & Bowen, 1988; Titelman, 1998). Theoretically, Bowen proposes that the level of adaptive functioning in family members, including children, reflects the level of differentiation in the family system (1978; Kerr & Bowen, 1988). Differentiation of self is defined as the degree to which one is able to balance (a) emotional and intellectual functioning and (b) intimacy and autonomy in relationships (Bowen, 1978; Skowron & Friedlander, 1998). In particular, greater differentiation of self in a family system is characterized by lower emotional reactivity, greater calm under stress, ability to distinguish between thoughts and feelings and a greater capacity for both intimacy and autonomy in relationships. Parents with higher levels of differentiation of self are better able to self-regulate, to think clearly in the midst of strong affect, and maintain a clear sense of self (Bowen, 1978; Titelman, 1998). More flexibility and ability to adapt are thought to be qualities that signify differentiation. Greater differentiation of self is thought to facilitate better management of emotional responses and consequently aiding in cognitive composure under stress. In contrast, less differentiated parents are less able to regulate their emotional responses or maintain a solid sense of self in relationships, are more emotionally reactive, and less comfortable with intimacy and/or autonomy in family relationships (Bowen, 1978; Kerr & Bowen, 1988). Therefore, this study sought to determine whether parents who are more differentiated have children who demonstrate greater cognitive competence. According to Bowen theory (1978), more differentiated parents are those who think clearly, regulate their emotions under stress and remain connected with their children while also supporting their autonomy. As such, these more differentiated parents would be expected to have children who are better able to engage in

academic learning and achieve greater cognitive competence. In other words, a parent's level of differentiation —that is, being able to modulate their emotional arousal, think clearly under stress, take an "I" position in relationships—should result in greater child cognitive function. Parent's ability to modulate their emotions provides relational experiences for the child to control their own emotional impulses and self-regulate when faced with stress (Skowron, 2005). Parents are the major influence among pre-school age children and formal education has not yet begun, therefore, the correlation observed between parent and child functioning would be at its highest in these pre-school years. In addition to learning behavior, a parent who is more capable of self-regulating will implement these abilities during interactions and the child may be more apt to learn and engage in this way when faced with stressful and frustrating tasks, such as challenging cognitive tests. Essentially, this research will provide information on the extent to which parent differentiation of self—in other words, their capacity for emotion regulation and comfort with defining a self in connection to others—predicts cognitive performance in early childhood.

The relationship between parent differentiation of self and child competence was recently examined. Skowron (2005) first analyzed relations between parent differentiation of self (Bowen, 1978) and cognitive proficiency in at-risk children. Participants were urban families from an African American/Black background. In a sample of 55 mother-child dyads, children ranged from 6 to 13 years. Skowron (2005) administered the Differentiation of Self Inventory (DSI; Skowron & Friedlander, 1998) to assess parents' emotional management while evaluating the child's verbal and math aptitude and academic self-concept. Skowron (2005) predicted and found that greater differentiation of self among mothers in low-income, urban families yields greater competence among their children, in spite of the family stress and neighborhood violence. A significant relationship between parent differentiation of self and child vocabulary scores was found, over and above neighborhood violence (distal) and family life stress (proximal). Furthermore, a significant relationship between parent DS and child cognitive ability was established even after accounting for parent level of education.

I will be replicating and extending this study. A slightly younger child population will be assessed. Children will range from the ages 3 to 5 years old. At 6 to 13, school has become a factor amongst other influencing factors. Children, ages 3-5, are not yet of school age and their main influence are parents. Moreover, the strength of the relationship between parent DS and child cognitive ability should be higher at this time due to the absence of external influences (not yet in school, etc.). A rural, at-risk sample, as opposed to urban, will be studied and results will be compared to the initial sample. In addition to these conditions, I will be using an alternative measure of child cognitive competence. The Vocabulary subtest of the Wechsler Intelligence Scale for Children-III (WISC–III; Wechsler, 1991) and the Arithmetic subtest of the Wide Range Achievement Test-3 (WRAT-3; Wilkinson, 1993) were used to measure verbal and math skills in Skowron (2005). Child cognitive ability is the central outcome variable being measured for this research. Comparatively, the Fifth Edition of the Stanford-Binet Intelligence Scale (SB-5) will measure fluid reasoning and verbal knowledge as single score. Lastly, the DSI will also be used to assess mom's capacity to manage emotional reactivity, take the "I" position in relationships, emotional cutoff and fusion with others. Multiple regression analysis will examine the role of the four components of differentiation of self

in predicting child cognitive ability.

   If the results mirror Skowron's (2005) findings, it would be a significant contribution to current knowledge about child achievement. If high cognitive achievement in a sample of at-risk rural, pre-school children is found to be associated with greater parent abilities to regulate emotional reactivity, think clearly under stress, and maintain good connection while also supporting autonomy, this would suggest several important avenues for intervention. Specifically, if future research were to find a causal link between parent DS and child cognitive functioning, then interventions designed to enhance caregiver (i.e. parent, teacher) DS could in turn have positive effects on improving children's cognitive performance and school success. In addition, such findings would signify the responsibility that experts have to share this knowledge and implement this emotional management system into models and teachings. Possible implications could include improved family therapy interventions as well as enhanced assessment and facilitation in academic settings such as student-teacher relationships.

Methods

Participants

   Participants will consist of 60 biological mother-child dyads, with the children ranging in age from 3 to 5 years. Mothers and their pre-school children were recruited through Centre, Clearfield, Blair, Huntington and Mifflin County Children & Youth Service agencies. The sample will be from a larger NIMH-funded project investigating relations between parenting processes and child self-regulation and behavior problems in at-risk families. Participating mothers will be 18 years of age or older, speak fluent English, must be the primary caregiver for their pre-school child, and live with their child at the time of study participation. Information about marital status, mothers' employment status, ethnic background, and household composition will be assessed and reported. In cases of multiple children who fall into target ages, a random selection will be made.

Instruments

   Parent differentiation of self. The full 46-item Differentiation of Self Inventory is a self-reported measure that will be used to assess ability to self-regulate in relationships with significant others as well as individually (DSI; Skowron & Friedlander, 1998; Skowron & Schmidt, 2003). The DSI is comprised of 4 subscales: Emotional Reactivity, Emotional Cutoff, difficulties taking an "I" Position, and Fusion with Others. The Emotional Reactivity scale assesses the ability to manage extreme and impulsive expressions of emotion (e.g., "At times my feelings get the best of me and I have trouble thinking clearly."). Emotional Cutoff displays distress in intimacy and feelings of excessive vulnerability in relationships (e.g., "When one of my relationships becomes very intense, I feel the urge to run away from it."). Fusion with Others asks questions pertaining to over involving oneself with others to see if the individual doesn't lose their emotional self in interpersonal relations (e.g., "I often feel unsure when others are not around to help me make a decision"). Lastly, the ability to take an "I" Position is exhibited by a strong sense of self and clear cognition even under external pressure and influence (e.g., "I usually do not change my behavior simply to please another person."; Skowron & Schmitt, 2003).

   The full DSI will be administered to the mother and a score will be calculated by

adding her responses (after reversing negative items) and then dividing that number by the total number of items on the scale to yield a score ranging from 1 to 6. Higher scores reflect less emotional reactivity, emotional cutoff and fusion with others as well as less difficulty taking an "I" Position and thus, a greater differentiation of self. Internal consistency reliability of the DSI scores will be calculated and compared to the estimate of .88 reported by Skowron and Friedlander (1998).

Child cognitive competence. The Early Stanford-Binet Intelligence Scale-Fifth Edition (SB5) is an individually administered assessment of intelligence and cognitive abilities customized for use with examinees ages 2 through 7 years, 3 months. The two major factors of child cognitive ability being measured are Non-Verbal Fluid Reasoning (FR) and Verbal Vocabulary Knowledge (KN). Fluid Reasoning is the ability to solve nonverbal (in this case) problems using inductive or deductive reasoning. It requires the ability to solve novel figural problems and to identify sequences of pictured objects or matrix-type geometric patterns. Vocabulary knowledge is a person's accumulated body of learned general information and requires the ability to apply this knowledge of concepts and language and to identify and define increasingly difficult words (Roid, 2003).

A single Abbreviated Battery IQ (ABIQ) score will be calculated. Scores range from 40 to 160 with the lower score signifying moderate impairment/delay and the higher score signifying giftedness/advancement. A hand scoring process is used to determine the examinee's exact chronological age, calculate raw and scaled score totals, and converting these scaled scores into standard T-scores with a mean of 100 and standard deviation of 15. Because the SB5 is being used as a part of a comprehensive examination, the ABIQ is used to provide a reliable estimate of a child's overall level of cognitive functioning. The reliability of the ABIQ, although good, is below that of the Full Scale IQ obtained from a more complete assessment. An average split-half reliability of .91 is reported by Roid and Barram (2004). Specifically, the average split-half reliability coefficient for children ages 3-5 on the Nonverbal Fluid Reasoning is .86 and .87 for Verbal Knowledge. The composite IQ scores of the SB5 were found to be highly correlated with composite scores from previous Stanford-Binet editions and all of the major IQ batteries, such as the Weschsler scales (Roid, 2003).

Demographic questionnaire. Parents will complete a demographic interview which includes information about age, gender, ethnicity, family structure and composition, living situation, relationship status, education, and any relevant concerns about target child. As a part of the larger research protocol, mothers also complete additional instruments which assess further life events and stressors.

Procedure

An initial sub-sample of families, drawn from up to 5 rural counties in central Pennsylvania, will be pulled from the larger NIMH-funded research project called the Family Study. Low income, rural families will be included for participation. A total of three 2-hour sessions are completed as part of the study protocol. During an initial screening visit, the brief SB-5 is among one of the measures administered to the child. A two-person research team blind to the referral source will travel to the home and administer this scale in a discreet interview design. A brief demographic questionnaire will be completed by the mother in this first visit. Also, study procedures will be

reviewed with the mom as well as attaining informed consent. During the second home visit, which is scheduled approximately 1-2 weeks after, the DSI will be one survey completed amongst several assessments. A third visit requires mother and child to travel to the Child Study Center at the University Park campus. There, they will participate in a series of joint parent-child tasks and child regulatory tasks. Transportation to and from the laboratory will be provided, if necessary. The laboratory playroom is set up with video cameras positioned to capture the behavior of both mother and child. Behind a one-way mirror, controls for the video cameras and ECG monitoring equipment (for both mom and child) are located. Regular rest breaks will be provided during all visits. Families are compensated a total of $150 for their participation in the three visit protocol.

Analytic Plans

A multiple regression analysis will be performed that maps the four DSI variable (Emotional Reactivity, Emotional Cutoff, "I" Position, and Fusion with Others) scores onto one criterion variable (SB-5 ABIQ score). The means and standard deviations of the DSI total scores and child cognitive competence SB5 scores will be calculated and presented. Then intercorrelations among parent differentiation and child competence will be reported. An omnibus F test will be run for the four predictor variables. Collectively, if the F-Test is significant ($p < .05$), then we can conclude there is a significant relationship between DSI and the criterion variable of child cognitive competence in the form of an SB5 score. The multiple r and R^2 will be computed to show the proportion of variance in child cognitive ability that can be accounted for by the scores on the predictor variable (DSI scores). Follow up T-tests will be completed on each of the four standardized beta-weights (β) or regression coefficients using $\alpha = .05$ to conclude which individual component has a unique/significant relationship to cognitive functioning. If the T-value is large enough, this will sufficiently display that the relationship between the variables is not likely due to chance.

Discussion

This study will examine whether parent differentiation of self accounts for variation in child cognitive competence among low-income, rural families. It is presumed that greater differentiation of self among mothers (measured by the 4 DSI subscales) will predict higher cognitive achievement in children. If the results were to provide empirical evidence for a relationship between mother's level of differentiation and the level of cognitive functioning in their child, this would lend support to Bowen's (1978; Kerr & Bowen, 1988) theory that the level of functioning in family members (i.e., children) echoes the level of differentiation in the family system (i.e., parents). Specifically, it could then be concluded that mom's ability to manage her emotional reactivity and maintain intimacy and autonomy facilitates a relational environment in which children are better able to think, reason and develop cognitively. Support for this hypothesis would suggest several implications for interventions focused on enhancing children's cognitive development. First, family therapy might be indicated as a viable intervention to enhance children's cognitive performance. Further, if positive results are found, they might suggest that individual parents who enhance their differentiation might indirectly benefit the family as a whole. Moreover, if one or more subscales of the DSI (Emotional Reactivity, Emotional Cutoff, "I" Position, and Fusion with Others) were to

have a significant, unique relationship with child cognitive functioning, it would advance our understanding of which aspects of parent differentiation of self seem to be particularly salient to child cognitive function. In short, family-based interventions might represent a beneficial set of strategies for helping children with cognitive delays and be a supplement to school-based interventions.

Alternatively, parent differentiation could fail to predict child cognitive competence. In this instance, we would not be able to conclude that there is a significant and stable relationship between parent DS and child cognitive ability among low-income rural families. Possible confounds should be considered such as parent IQ and child maltreatment as accounting for such large amounts of variation in child cognitive ability that parent DSI scores are rendered insignificant. Additionally, instead of the pre-school sample rendering a stronger relationship because of the lack of external influences, it could have the opposite effect. Perhaps the children are too young for the parent's differentiation ability to garner significant effects on their cognitive ability. Furthermore, it could be that different characteristics predict child cognitive ability in rural but not urban settings. Bowen theory suggests that associations between parent differentiation of self and child competence are expected in family systems across the socioeconomic spectrum. While family socioeconomic markers and stressors are said to have a direct influence on the academic successes of young people, these effects may be moderated by external strategies such as community involvement (Russell & Elder, 1997). Small community members rely upon the participation of as many community members as possible (Salamon, 1992). Children living in small and farm towns displayed higher academic success than non-farm children reasoning being that farming is associated with strong community ties (Russell & Elder, 1997). In rural communities, parental ties to community (i.e., church involvement, leadership, formal religion, etc.) enhance the educational influence on children (Coleman, 1988).

Less work has been done to determine the cross-cultural validity of Bowen family systems theory (Bowen, 1976, 1978; Kerr & Bowen, 1988). The purpose of Skowron's (2004) study was to examine the theory's relevance, specifically differentiation of self, for persons of color. Sixty-one undergraduate and graduate ethnic minority students (African-American, Latino/a, Native American, Asian American, and Multiethnic) attending a large, Midwestern university, completed the differentiation of self inventory, an interview of ethnic group belonging, and 3 indices of personal adjustment—psychological, physical, social problem-solving. Higher levels of differentiation of self predicted better psychological adjustment, social problem-solving abilities, and greater ethnic group belonging among the minority college students. The DSI scores obtained from the students were moderate and comparable to those of a European American sample similar in terms of age and gender. There is still a debate as to whether the concept of differentiation of self is applicable for persons of color from non-Western cultures. This study only garnered preliminary evidence for the cross-cultural efficacy of Bowen family systems theory. Continued studies are needed to directly examine relations between differentiation of self and personal adjustment within diverse ethnic, cultural, and socioeconomic groups (Skowron, 2004). Moreover, a more comprehensive research study would be needed to conclude if there are more central qualities in the parent other than modification of emotion and maintaining an autonomous self with intimacy in relationships that will affect the child's cognitive abilities.

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Some Overpartition k-tuple Congruence Properties

Robert G. Vary, McNair Scholar, The Pennsylvania State University

Faculty Research Advisor: Dr. James A. Sellers
Director of Undergraduate Studies
Department of Mathematics
Eberly College of Science
The Pennsylvania State University

1 Historical Background and Basic Theory

1.1 What is an ``integer partition''?

The following definition is offered in [1]:

Definition 1.1 *An integer partition is a way of splitting a number into integer parts.*

The idea is very simple, as shown in the following example. Consider the integer 5. The question to ask is: how can 5 be written as a combination of positive integers less than or equal to 5? By simple inspection, we yield the following list of answers:

$$5, \ 4+1, \ 3+2, \ 3+1+1, \ 2+2+1, \ 2+1+1+1, \ 1+1+1+1+1$$

Each of the elements of this list is itself a partition, and the numbers in each partition are referred to as **parts** . As one may clearly deduce, the larger the number, the more partitions it has. Also of note is the fact that $2+1+1+1$ is the same as $1+2+1+1$, that is, order is not accounted for. Typically, the parts of a partition are written in nonincreasing order. It is also commonly accepted that the function $p(n)$, where n is a positive integer, is the function which counts the number of partitions of n.

The next question typically asked by one who studies partitions is, ``What different restrictions can I put on two sets of partitions to yield the same number of partitions?'' As described in [1], the great mathematician Leonhard Euler asked this question and provided a host of solutions, most commonly referred to as Euler Identities. For example, let's again consider the number 5. Consider first the partitions of 5 that contain only distinct parts:

$$5, \ 4+1, \ 3+2$$

Now, consider partitions of 5 containing only odd parts:

$$5, \ 3+1+1, \ 1+1+1+1+1$$

As is easily seen, both of the lists contain the same number of partitions. Indeed, one can show that for any positive number, the number of partitions into odd parts is exactly the number of partitions into distinct parts. In fact, the following stronger statement is true, where $p(n)$ is the number of partitions of n:

Theorem 1.2 (Euler Pairs)
$$p(n \text{ with parts in } N) = p(n \text{ with distinct parts in } M) \ for \ n \geq 1,$$
where N is any set of integers such that no element of N is a power of two times an element of N, and M is the set containing all elements of N together with all their multiples of powers of two.

1.2 Congruences

Definition 2.1 *Consider two integers m and n. If n has remainder r when divided by m, then n is said to be* **congruent** *to r modulo m, denoted by*

$$n \equiv r \qquad (\mathrm{mod} \, m).$$

In the above definition, if n is divisible by m, then this means $r = 0$. Thus $n \equiv 0 (\mathrm{mod} \, m)$. For further understanding, refer to the following example.

Example 1 *Let* $m = 4$. *Let* $a = 1$, $b = 6$, $c = -1$, $d = 16$, $e = 26$, *and* $f = -15$. *Then*

$$a \equiv 1 \quad (\mathrm{mod} \, 4), \qquad\qquad\qquad d \equiv 0 \quad (\mathrm{mod} \, 4),$$
$$b \equiv 2 \quad (\mathrm{mod} \, 4), \qquad\qquad\qquad e \equiv 2 \quad (\mathrm{mod} \, 4),$$
$$c \equiv 3 \quad (\mathrm{mod} \, 4), \qquad\qquad\qquad f \equiv 1 \quad (\mathrm{mod} \, 4).$$

1.3 Generating Functions

As discussed in [1], the entire idea of generating functions for integer partitions lies solely on the following fact:
$$q^a \times q^b = q^{a+b}$$

To use this fact in finding all integer partitions with one even part and one odd part, each of which is less than 5, consider the following:

$$(q^2 + q^4)(q^1 + q^3) = q^{2+1} + q^{2+3} + q^{4+1} + q^{4+3} \tag{1.3.1}$$
$$= q^3 + q^5 + q^5 + q^7 \tag{1.3.2}$$
$$= q^3 + 2q^5 + q^7. \tag{1.3.3}$$

Upon further inspection, it is obvious that (1.3.1) lists in each exponent all of the partitions satisfying the aforementioned condition. This can be generalized. Let $S = \{n_1, n_2, n_3\}$, with each n_i a positive integer. Then consider $(1 + q^{n_1})(1 + q^{n_2})(1 + q^{n_3})$

$$= 1 + q^{n_1} + q^{n_2} + q^{n_3} + q^{n_1 + n_2} + q^{n_1 + n_3} + q^{n_2 + n_3} + q^{n_1 + n_2 + n_3}. \qquad (1.3.4)$$

This expression displays all partitions using distinct members of the set S.

    Example 2 *Let* $S = \{1, 2, 3\}$. *Then the polynomial from (1.3.4) becomes:*

$$1 + q + q^2 + 2q^3 + q^4 + q^5 + q^6$$

With that in mind, the following definition is now available.

    Definition 3.1 *A polynomial or power series whose coefficients represent the number of partitions of its exponents is called a* **generating function** . *This function also allows for certain restrictions to be placed upon the parts.*

In Example 2, the generating function is counting the number of partitions into distinct elements from the set S. This leads to the following fact for a set of positive integers $S = \{n_1, n_2, \ldots, n_r\}$:

$$\sum_{n \geq 0} p(n \text{ with distinct parts in } S) q^n = \prod_{i=1}^{r} (1 + q^{n_i}) = \prod_{n \in S} (1 + q^n).$$

This can also be used if we want to allow parts to only repeat a certain number of times. For instance, suppose we want each part to appear up to 3 times in any partition, and that we only want to use parts from $S = \{n_1, n_2\}$. Then,

$$(1 + q^{n_1} + q^{n_1 + n_1} + q^{n_1 + n_1 + n_1})(1 + q^{n_2} + q^{n_2 + n_2} + q^{n_2 + n_2 + n_2})$$

$$= 1 + q^{n_2} + q^{n_2 + n_2} + q^{n_2 + n_2 + n_2} + q^{n_1} + q^{n_1 + n_2} + q^{n_1 + n_2 + n_2}$$
$$+ q^{n_2 + n_2 + n_2 + n_2} + q^{n_1 + n_1} + q^{n_1 + n_1 + n_2} + q^{n_1 + n_1 + n_2 + n_2}$$
$$+ q^{n_1 + n_1 + n_2 + n_2 + n_2} + q^{n_1 + n_1 + n_1} + q^{n_1 + n_1 + n_1 + n_2} + q^{n_1 + n_1 + n_1 + n_2 + n_2}$$
$$+ q^{n_1 + n_1 + n_1 + n_2 + n_2 + n_2}$$

$$= \sum_{n \geq 0} p(n \text{ with parts in } \{n_1, n_2\}, \text{ no part repeated more than 3 times}) q^n.$$

If $S = \{n_1, \ldots, n_r\}$, then

$$\sum_{n \geq 0} p(n \text{ with parts in } S, \text{none repeated more than } d \text{ times}) q^n$$

$$= \prod_{i=1}^{r} (1 + q^{n_i} + q^{n_i + n_i} + \cdots + q^{\overbrace{n_i + \cdots + n_i}^{d \text{ times}}})$$
$$= \prod_{i=1}^{r} (1 + q^{n_i} + q^{2n_i} + \cdots + q^{dn_i})$$
$$= \prod_{i=1}^{r} \frac{(1 - q^{(d+1)n_i})}{(1 - q^{n_i})} = \prod_{n \in S} \frac{1 - q^{(d+1)n}}{1 - q^n}$$

The end of the previous list of equalities is true due to the following known formula for the finite geometric series:

$$\sum_{j=0}^{N} x^j = \frac{1-x^{N+1}}{1-x}$$

By letting $d \to \infty$, we can see that the generating function is still meaningful for letting parts appear an arbitrary number of times. We now must require $|q| < 1$, which is not a problem since we do not substitute a value for q. So, for $|q| < 1$,

$$\sum_{n \geq 0} p(n \text{ with parts in } S) q^n = \prod_{i=1}^{\infty} (1 + q^{n_i} + q^{2n_i} + \cdots)$$
$$= \prod_{i=1}^{\infty} \frac{1}{1-q^{n_i}} = \prod_{n \in S} \frac{1}{1-q^n}.$$

Here, the formula for an infinite geometric series was used:

$$\sum_{j=0}^{\infty} x^j = \frac{1}{1-x}, \quad |x| < 1$$

Thus, we have a representation for the generating functions of the number of partitions for many more cases than we did originally. These generating functions are instrumental for successfully proving results.

2 Definitions, Notation and Terminology

2.1 What is an ``overpartition''?

In the study of partitions there are always new constructions appearing. Consider $n = 5$. We already know its partitions:

$$5, \ 4+1, \ 3+2, \ 3+1+1, \ 2+2+1, \ 2+1+1+1, \ 1+1+1+1+1$$

Our new objective is to expand these results into some sort of new idea, then see if our new list has any interesting properties. And, if our new construction is done well enough, our ultimate goal is to relate it back to unrestricted integer partitions. So, let's consider a new list, with each element abiding by these rules:
- It is a partition of n.
- The first occurence of any part may be overlined.

So, how does this change our list for $n = 5$? Our new list is as follows:

$$5, \ 4+1, \ 3+2, \ 3+1+1, \ 2+2+1, \ 2+1+1+1,$$
$$1+1+1+1+1, \ \overline{5}, \ \overline{4}+\overline{1}, \ \overline{4}+1, \ 4+\overline{1}, \ \overline{3}+\overline{2},$$
$$\overline{3}+2, \ 3+\overline{2}, \ \overline{3}+\overline{1}+1, \ \overline{3}+1+1, \ 3+\overline{1}+1,$$
$$\overline{2}+2+\overline{1}, \ \overline{2}+2+1, \ 2+2+\overline{1}, \ \overline{2}+\overline{1}+1+1,$$
$$2+\overline{1}+1+1, \ 2+1+1+1, \ 1+1+1+1+1$$

This example motivates the following definition, as stated in [6].

Definition 1.1 *An **overpartition** of n is a non-increasing sequence of natural*

numbers whose sum is n in which the first occurrence of a number may be overlined.

Throughout, the number of overpartitions of a number n will be denoted by $\overline{p}(n)$, with $\overline{p}(0) = 1$. Also from [6] we have the following generating function for $\overline{p}(n)$:

$$\sum_{n=0}^{\infty} \overline{p}(n)q^n = \prod_{n=1}^{\infty} \frac{1+q^n}{1-q^n} = 1 + 2q + 4q^2 + 8q^3 + 14q^4 + \cdots \tag{5}$$

2.2 Overpartition Pairs and k-tuples

Overpartitions have been studied quite a bit recently, such as in [4], [5], [7], [9], and [12]. As an expansion of overpartitions, the following new construction appeared in [10].

Definition 2.1 *An **overpartition pair** (λ, μ) of n is a pair of overpartitions where the sum of all listed parts is n.*

Example 3 *The overpartition pairs for $n = 2$ are:*

$$(2 ; \emptyset), (\overline{2} ; \emptyset), (1+1 ; \emptyset), (\overline{1}+1 ; \emptyset),$$
$$(1 ; 1), (1 ; \overline{1}), (\overline{1} ; 1), (\overline{1} ; \overline{1}), (\emptyset ; 2),$$
$$(\emptyset ; \overline{2}), (\emptyset ; 1+1), (\emptyset ; \overline{1}+1).$$

The number of overpartition pairs of n were denoted in [10] by $\overline{pp}(n)$. Also in [10], it was discovered that the generating function for $\overline{pp}(n)$ is

$$\sum_{n=0}^{\infty} \overline{pp}(n)q^n = \prod_{n=1}^{\infty} \left(\frac{1+q^n}{1-q^n}\right)^2 = 1 + 4q + 12q^2 + 32q^3 + 76q^4 + \cdots,$$

This generating function was derived from the generating function for overpartitions. Noting how similar this generating function looks compared to the generating function for $\overline{p}(n)$, one can now expand on this idea easily.

Definition 2.2 *An **overpartition k-tuple** of n is a k-tuple of overpartitions $(\lambda_1, \ldots, \lambda_k)$ wherein all listed parts sum to n.*

We will denote the number of overpartition k-tuples by $\overline{p}_k(n)$, which subsequently means $\overline{pp}(n) = \overline{p}_2(n)$. Based on the generating function for overpartition pairs, it is clear that the generating function for overpartition k-tuples is

$$\sum_{n>0} \overline{p}_k(n)q^n = \prod_{n=1}^{\infty} \left(\frac{1+q^n}{1-q^n}\right)^k.$$

3 Known Congruences

3.1 Ramanujan

The great mathematician Srinivasa Ramanujan (1887-1920) discovered and

proved countless theorems in many fields, including number theory. Directly pertinent to this study, and providing most of the inspiration, are the following congruences that Ramanujan proved about partitions.

Theorem 1.1 *For all $n \geq 0$,*

$$p(5n+4) \equiv 0 \quad (\bmod\, 5),$$
$$p(7n+5) \equiv 0 \quad (\bmod\, 7), \text{and}$$
$$p(11n+6) \equiv 0 \quad (\bmod\, 11).$$

For example, here are tables showing $p(n)$ for some values of $5n+4$, $7n+5$, and $11n+6$.

n	$5n+4$	$p(5n+4)$
0	4	5
1	9	30
2	14	135
3	19	490
4	24	1575

n	$7n+5$	$p(7n+5)$
0	5	7
1	12	77
2	19	490
3	26	2436
4	33	10143

n	$11n+6$	$p(11n+6)$
0	6	11
1	17	297
2	28	3718
3	39	31185
4	50	204226

3.2 Overpartition and Overpartition Pair Congruences

Similar to the above, there are many interesting congruences related to $\overline{p}(n)$ and $\overline{p}_2(n)$. Some are straightforward, and others take a bit of work to prove. The following is a table of the first few values of the overpartition function.

n	$\overline{p}(n)$
1	2
2	4
3	8
4	14
5	24
6	40
7	64
8	100
9	154
10	232

Clearly, it appears that all of the values for $\overline{p}(n)$ are even. In fact, the next theorem proves just that.

Theorem 2.1 *For all $n \geq 1$, $\overline{p}(n) \equiv 0 \pmod 2$.*

Proof.

$$\sum_{n=0}^{\infty} \overline{p}(n)q^n = \prod_{i=1}^{\infty} \frac{1+q^i}{1-q^i} \equiv \prod_{i=1}^{\infty} \frac{1+q^i-2q^i}{1-q^i} \pmod 2$$

$$= \prod_{i=1}^{\infty} \frac{1-q^i}{1-q^i}$$

$$= 1.$$

Therefore, $\sum_{n=1}^{\infty} \overline{p}(n)q^n \equiv 1 \pmod 2$

$$\equiv 1q^0 + 0q^1 + 0q^2 + 0q^3 + \cdots \pmod 2.$$

Since the coefficients of the terms on the right correspond to the same ones on the left, we see that for $n \geq 1$, $\overline{p}(n) \equiv 0 \pmod 2$.

The next theorem follows from results in [11].

Theorem 2.2 *For all $n > 0$,*

$$\overline{p}(n) \equiv \begin{cases} 2 \pmod 4 & \text{if } n \text{ is a square}; \\ 0 \pmod 4 & \text{otherwise.} \end{cases}$$

Here's a table of the first twenty values for the overpartition function. It is easy to see that $p(n) \equiv 0 \pmod 4$ for all n that are not square.

n	$\overline{p}(n)$		n	$\overline{p}(n)$		n	$p(n)$		n	$p(n)$
1	2		6	40		11	344		16	2062
2	4		7	64		12	504		17	2864
3	8		8	100		13	728		18	3948
4	14		9	154		14	1040		19	5400
5	24		10	232		15	1472		20	7336

The next two theorems, proved in [8], are a little more involved.

Theorem 2.3 *Let $\overline{p_o}(n)$ be the number of overpartitions of n into odd parts. Then*

$$\overline{p_o}(n) \equiv \begin{cases} 2 \pmod 4 & \text{if } n \text{ is a square or if } n \text{ is twice a square}; \\ 0 \pmod 4 & \text{otherwise.} \end{cases}$$

Theorem 2.4 *Let $\overline{p_o}(n)$ be the number of overpartitions of n into odd parts. Then, for all $n \geq 0$ and for all $\alpha \geq 0$,*

$$\overline{p_o}\left(9^\alpha(9n+6)\right) \equiv 0 \pmod{12} \quad \text{and}$$
$$\overline{p_o}\left(9^\alpha(27n+9)\right) \equiv 0 \pmod 6.$$

Finally, we have a theorem in the spirit of Ramanujan about overpartition pairs, as proven in [2].

Theorem 2.5 *For all natural numbers n,*

$$\overline{p}_2(3n+2) \equiv 0 \pmod{3}.$$

What follows is a table of the first 15 values for the overpartition pairs function. In checking the function for values of $3n+2$, one can see that they are all divisible by 3.

n	$\overline{p}_2(n)$
1	4
2	12
3	32
4	76
5	168

n	$\overline{p}_2(n)$
6	352
7	704
8	1356
9	2532
10	4600

n	$\overline{p}_2(n)$
11	8160
12	14176
13	24168
14	40512
15	66880

4 New Results

The major goal of this research is to see if previous results about overpartitions and their pairs could be extended to similar results for overpartition k-tuples. The forthcoming results accomplished this goal and more. In fact, a few of the aforementioned theorems can be more easily proven now, as they are simply corollaries of the new results.

Theorem 4.1 *For all n>0 and all nonnegative integers m, we have*

$$\overline{p}_{2^m}(n) \equiv 0 \pmod{2^{m+1}}.$$

Proof.

$$\sum_{n=0}^{\infty} \overline{p}_{2^m}(n)q^n = \prod_{i=1}^{\infty}\left[\frac{1+q^i}{1-q^i}\right]^{2^m}$$

$$\equiv \prod_{i=1}^{\infty}\left[\frac{1+q^i+2^{m+1}q^i}{1-q^i}\right]^{2^m} \pmod{2^{m+1}}$$

$$= \prod_{i=1}^{\infty}\left[1+\frac{(2^{m+1}+2)q^i}{1-q^i}\right]^{2^m}$$

$$= \prod_{i=1}^{\infty}\left[1+2\left(\frac{(2^m+1)q^i}{1-q^i}\right)\right]^{2^m}$$

$$= \prod_{i=1}^{\infty}\left[\sum_{n=0}^{2^m}\binom{2^m}{n}2^n\left(\frac{(2^m+1)q^i}{1-q^i}\right)^n\right] \text{ by } [3, \text{ Theorem 5.2.1}]$$

$$= \prod_{i=1}^{\infty}\left[1+2^{m+1}\left(\frac{(2^m+1)q^i}{1-q^i}\right)+2^{m+1}(2^m-1)\left(\frac{(2^m+1)q^i}{1-q^i}\right)^2\right.$$

$$\left.+\cdots+2^{(m+2^m-1)}\left(\frac{(2^m+1)q^i}{1-q^i}\right)^{2^m-1}+2^{2^m}\left(\frac{(2^m+1)q^i}{1-q^i}\right)^{2^m}\right]$$

$$\equiv 1 \pmod{2^{m+1}}$$

Thus, the congruence shown is

$$\sum_{n=0}^{\infty}\overline{p}_{2^m}(n)q^n \equiv 1 \pmod{2^{m+1}}$$

$$\equiv 1 + 0q + 0q^2 + 0q^3 + \cdots \pmod{2^{m+1}}.$$

Since coefficients on either side correspond, and $\overline{p}_{2^m}(0) = 1$ by definition, the preceding implies

$$\overline{p}_{2^m}(n) \equiv 0 \pmod{2^{m+1}}$$

for all $n > 0$ and for all nonnegative integers m.

With this theorem in hand, a broader theorem is easily proved.

Theorem 4.2 *Let $\overline{p}_k(n)$ count the number of overpartition k-tuples of n. Let $k=(2^m)r$, where m is a nonnegative integer and r is odd. Then, for all positive integers n,*
$$\overline{p}_k(n) \equiv 0 \pmod{2^{m+1}}.$$

Proof.

$$\sum_{n=0}^{\infty} \overline{p}_k(n)q^n = \prod_{i=1}^{\infty} \left[\frac{1+q^i}{1-q^i}\right]^k = \prod_{i=1}^{\infty} \left[\frac{1+q^i}{1-q^i}\right]^{(2^m)r}$$

$$= \prod_{i=1}^{\infty} \left(\left[\frac{1+q^i}{1-q^i}\right]^{2^m}\right)^r$$

$$\equiv \left(\prod_{i=1}^{\infty} \left[\frac{1+q^i}{1-q^i}\right]^{2^m}\right)^r$$

$$\equiv 1^r \pmod{2^{m+1}} \text{ using Theorem 4.1}$$
$$\equiv 1 \pmod{2^{m+1}}.$$

Just as in Theorem 4.1, the result follows.

After acquiring Theorems 4.1 and 4.2, it seemed something may also occur when k and the modulus are simply prime. This is indeed the case as the next theorem shows.

Theorem 4.3 *For all $k > 0$ and all n such that $n \not\equiv 0 \pmod{r^k}$, where r is an odd prime, we have*
$$\overline{p}_{r^k}(n) \equiv 0 \pmod{r}.$$

Proof.

$$\sum_{n=0}^{\infty} \overline{p}_{r^k}(n)q^n = \prod_{i=1}^{\infty} \left(\frac{1+q^i}{1-q^i}\right)^{r^k} = \prod_{i=1}^{\infty} \frac{(1+q^i)^{r^k}}{(1-q^i)^{r^k}}$$

$$\equiv \prod_{i=1}^{\infty} \frac{1+q^{ir^k}}{1-q^{ir^k}} \pmod{r}.$$

Upon expanding this last product as a power series, the only surviving (non-zero) exponents remaining are all multiples of r^k. Thus, $\overline{p}_{r^k}(n) \equiv 0 \pmod{r}$ for all positive integers k and for all $n \not\equiv 0 \pmod{r^k}$.

5 The Road Ahead

The new results from the last section are only the beginning of the discovery of many results for overpartition k-tuples. From here, the goal is to find other congruences and identities for different overpartition k-tuples. Some possibilities include:

Conjecture 5.1 *For all $n > 0$,*

$$p_{q-1}(qn + r) \equiv 0 \pmod{q}$$

where q is prime and r is a quadratic nonresidue mod q.

Theorem 2.5 is a direct corollary of the preceding conjecture.

Conjecture 5.2 *For all integers $m > 0$, we have*

$$\overline{p}_{2^m}(n) \equiv \begin{cases} 2^{m+1} & \pmod{2^{m+2}} & \text{if } n \text{ is a square or twice a square,} \\ 0 & \pmod{2^{m+2}} & \text{otherwise.} \end{cases}$$

Conjecture 5.3 *Let $\overline{p}_k(n)$ count the number of overpartition k-tuples of n. Let $k=(2^m)r$, $m > 0$ and r is odd. Then,*

$$\overline{p}_k(n) \equiv \begin{cases} 2^{m+1} & \pmod{2^{m+2}} & \text{if } n \text{ is a square or twice a square,} \\ 0 & \pmod{2^{m+2}} & \text{otherwise.} \end{cases}$$

Conjectures 5.2 and 5.3 simply involve raising the power of two in the modulus. They are also inspired by [11]. From here, the intention is to ultimately write a paper co-authored with Dr. Sellers and fellow Penn State student Derrick Keister and publish it in a peer-reviewed journal. It will be submitted by October 2008.

120

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Children at Double Jeopardy:
Socio-emotional Outcomes of Premature Infants Living in Poverty

Tiffany A. Velez, McNair Scholar, The Pennsylvania State University

Faculty Research Adviser: Dr. Douglas M. Teti
Professor-in-Charge, Ph.D. program, Human Development and Family Studies
Professor of Human Development, Human Development and Family Studies and Psychology
College of Health and Human Development
The Pennsylvania State University

Abstract

Early childhood development is one of the most crucial periods of human development. This fundamental period is not uniform for all children. Obstacles and challenges often arise hindering the process. This study focuses on the specific obstacles and challenges of prematurity and poverty on a particular set of socio-emotional outcomes. These include the questions 1) Are there any direct effects of prematurity and poverty on parenting, quality of attachment, and behavioral problems and competencies? 2) Are the effects of prematurity and poverty indirect, via their direct effects on parenting? To what degree does parenting matter in predicting socio-emotional outcomes in these infants? 3) If parenting does matter, what predicts individual differences of parenting in poverty? In this study, these outcomes and effects will be critically analyzed and discussed.

Prematurity

In 2003, 1 in 8 children (12.3% of live births) were born prematurely in the United States. (March of Dimes, 2005). A child is considered premature when they are born before the normal 37-40 weeks of gestation. Being born too soon may have direct effects on brain development, and may cause problems with some medical treatments that must be administered. (Aylward, 2005) This can be attributed to the fact that the infant is now developing outside of it normal environment, which at that time would be the mother's womb. Prematurity impedes a child's well-being; this affects their early years but will also carry on into their later development. Premature children experience higher instances of grade retention, learning disabilities, and school dropout as older children and adolescents. (Brooks-Gunn et al., 1997; Lamb, 1999). These factors can make the parenting of premature infants difficult.

In addition, to the stress and anxiety of being new parents, parents of premature infants are themselves "premature", having given birth to a baby that came unexpectedly. Because of this, parents of premature infants experience high levels of distress

(depression, anxiety, guilt), which are associated with poor parenting (Teti et al., 1996). Also, premature infants' social signals and needs are difficult to "read" by parents, making parenting the premature infant more challenging than parenting a full-term infant. Because premature infants tend to be more lethargic, the mothers work harder to create and sustain interactions but receive fewer positive responses from the premature infants in comparison to full term babies. (Singer et al., 2003, Bartlett et al., 2006)

It is an unfortunate truth that there are higher rates of premature births among families living in lower socioeconomic statuses. Prematurity rates are also reported to be higher among African Americans. According to the March of Dimes, in 2002, 17.7% of all live premature births were born to African American mothers. (March of Dimes, 2004) With the developmental hazard of prematurity against them, the added burden of living in poverty further hinders a child's development.

Poverty

Approximately 296,450 families are currently living at or below the federally established poverty threshold. (U.S. Bureau of Census, 2007) These families are living in impoverished neighborhoods that can affect both the child's development and parenting. (Evans, 2004; McLoyd, 1998) Living in these impoverished neighborhoods may directly affect development; this may be the result of higher levels of toxins, such as lead, water and air pollutants, substandard living, lower levels of cognitive stimulation, higher rates of violent crimes and illegal substance use that the child is exposed to. Parenting is affected because not only is the parent trying to construct and sustain a safe and secure environment for their child within their home they must also be conscience and wary of what is going on within the neighborhood.

In these impoverished families are children who are unfortunately entering society at a disadvantage. The disadvantage encountered is these families are unable to provide financial and/or emotional support for their children. Without this, much needed support the children suffer. This highlights that poverty can affect children directly and indirectly, it directly affects children through its influence on their development. Indirectly, it affects children through such mechanisms as parenting.

A parent's ability to provide effective, compassionate, and supportive care becomes compromised when stressors such as poverty, economic loss, and prematurity affect the family unit. (McLoyd, 1997; Yates, Egeland, and Sroufe, 2003) Also, socioeconomic instability has a negative effect on parenting which in turn is thought to be the primary mediator between poverty and a child's development. (Yates, Egeland, and Sroufe, 2003) Mounting stressors may cause parents to react harshly and implement physical methods of punishment. Poverty may also cause parents to become withdrawn and uninvolved in their child's life. These harsher, but sometimes nonexistent, forms of discipline may have lasting effects. A child's impression of the world as volatile, unsafe, and irregular can stem from the erratic and unpredictable care they received in their early years. (Yates, Egeland, and Sroufe, 2003)

Many children succumb to the pressure that poverty and negative life experiences put upon them and travel along the same path that have always known. The children in the present study are at risk for poor developmental outcomes for at least two reasons. First, they were born too soon, and are at medically and environmentally at risk. Second,

they have been exposed to adversity in the form of poverty and its associated stressors.

Within the study there are three questions to be asked 1) Are there any direct effects of prematurity and poverty on socio-emotional development among African American premature infants in low-income families? 2) Are the effects of prematurity and poverty indirect, via their direct effects on parenting? To what degree does parenting matter in predicting socio-emotional outcomes in these infants? 3) If parenting does matter, what predicts individual differences of parenting in poverty?

Methods

Participants

The data used in this study came from an intervention study, *The Preterm Infant Development Study,* conducted by Dr. Douglas M. Teti. The original study was designed to evaluate and promote maternal sensitivity and infant development. The intervention portion of the study will not be discussed in this one.

For the study 173 families were recruited, the participants were selected from four Neonatal Intensive Care Units (NICUs) within the Baltimore/Washington, D.C. metropolitan area. All of the participants were of African American descent and all the mothers were older than the age of eighteen at the time of the study (M =26.77yrs.). Mothers had refrained from taking any drugs during their time of pregnancy, this was determined in two ways, a maternal self-report or toxicity screening. Of the 173 families, involved 78 % of families were on public assistance and in addition, 54 % of the mothers involved were not married/living with a partner. The infants involved in the study were all born prematurely, *M gestational age = 30.12 wks* (range was from 28-38 weeks). *M birth weight = 1409.15 gms* (range 480 – 3150 gms). Among the infants, involved 57 % were females. (Teti et al., 2006)

Procedure

Assessments were conducted at several points during the infant's development. A baseline assessment at 32-36 weeks, another at 54-58 weeks post-conceptual age (3-4 months corrected for prematurity), and the final sets at 12 and 24 months, also corrected for prematurity. During these assessments three socio-emotional outcomes were evaluated, quality of infant-mother attachment, and infant behavior problems and behavior competencies. In addition, maternal sensitivity was assessed at 54-58 wks, 12, and 24 months of age.

Measures

Attachment Q-Set

The Attachment Q-Set (AQS) (Waters, 1995) was used to measure security and quality of infant-mother attachment. It is a collection of 90 cards describing various scenarios/statements of child attachment behaviors. These cards are sorted into groupings numbered from 1-9 (1-most unlike the child, 9- most like the child), by trained observer(s), on whether or not the scenarios/statements described on the card is

characteristic of the observed child. The scores collected from the observations are then correlated against a set of averaged criterion scores based upon the theoretical "most secure" child, to determine how securely attached the child is to the mother. (Teti, 1996)

Maternal Behavior Q-Set

The Maternal Behavior Q-Set (MBQ) (Pederson, Moran, 1995) was used to measure maternal sensitivity. It is a collection of 90 cards describing various scenarios/statements related to maternal sensitivity. These cards are sorted into groupings numbered from 1-9 (1-most unlike the mother, 9- most like the mother), by trained observer(s), on whether or not the scenarios/statements described on the card is characteristic of the observed mother. The scores collected from the observations are then correlated against a set of averaged criterion scores based upon the theoretical "most sensitive" mother and determined how sensitive the mother was to her child's needs.

Brief Infant and Toddler Social and Emotional Assessment

The Brief Infant and Toddler Social and Emotional Assessment (BITSEA) (Briggs-Gowan, 2004) is an evaluation for social-emotional behavioral problems and delays in competency. The 42-item questionnaire is to be filled out by the child's parent/caregiver to assess the child's behavioral problems, competencies and/or delays, if such occur.

Results

The statistical analyses used for this study were run using the computer program, SPSS. For each variable identified separate analysis were run. For prematurity, correlations of prematurity (GA at birth) were run in regards to outcome assessments. For poverty, a one-way analysis of variance (ANOVA) comparing parents living in poverty versus parents not living in poverty was conducted. For parenting, correlations and ANOVA examining links between prematurity, poverty, and parenting were run. In addition, a final set of mediation analyses examining whether parenting mediates any links between prematurity and poverty and infant developmental outcomes. Each research question will be addressed separately.
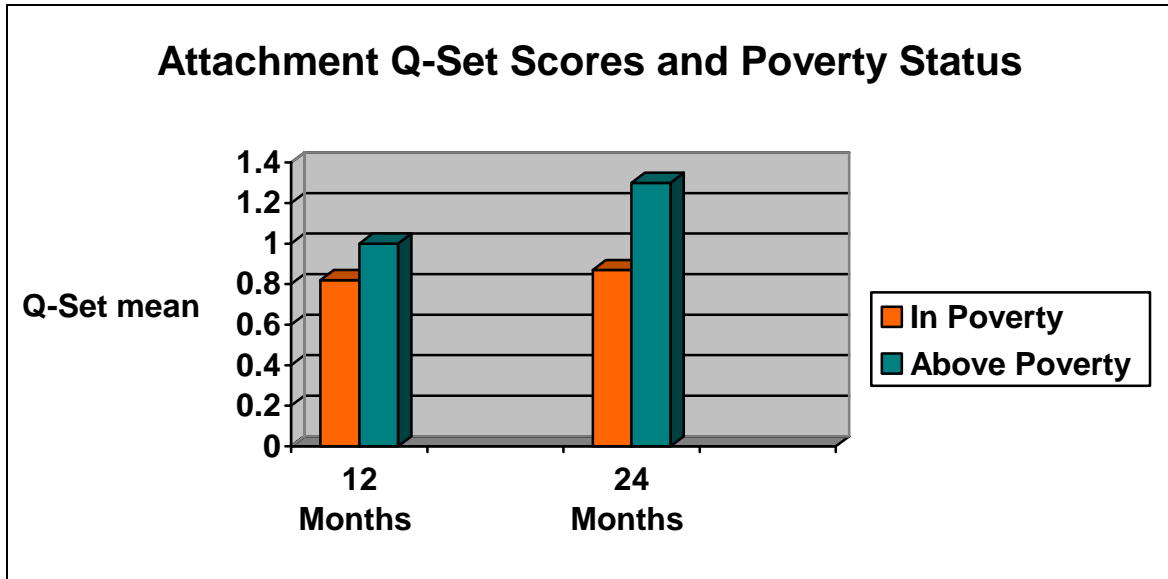
Research Question #1 (restated):

Are there any direct effects of prematurity and poverty on socio-emotional development among African American premature infants in low-income families?

When the relationship between prematurity and socio-emotional development was examined it was found that gestational age had no association between either infant-mother security of attachment or infant behavioral problems and behavioral competencies at 12 and 24 months. On the other hand, poverty status and security of attachment were

significantly associated; for families living below poverty thresholds, infant-mother attachment at 12 months (p <.05) and 24 months (p <.01) were not as secure as infant-mother attachment for dyads living above poverty thresholds. (See Figure 1)

Figure 1.

Attachment Q-Set Scores and Poverty Status

Behavioral problems were also significantly higher among children living below poverty thresholds at 12 months (p<.00) and at 24 months (p<.05). (See Figure 2)

Figure 2.

**Behavioral problems scores (BITSEA) and poverty status**
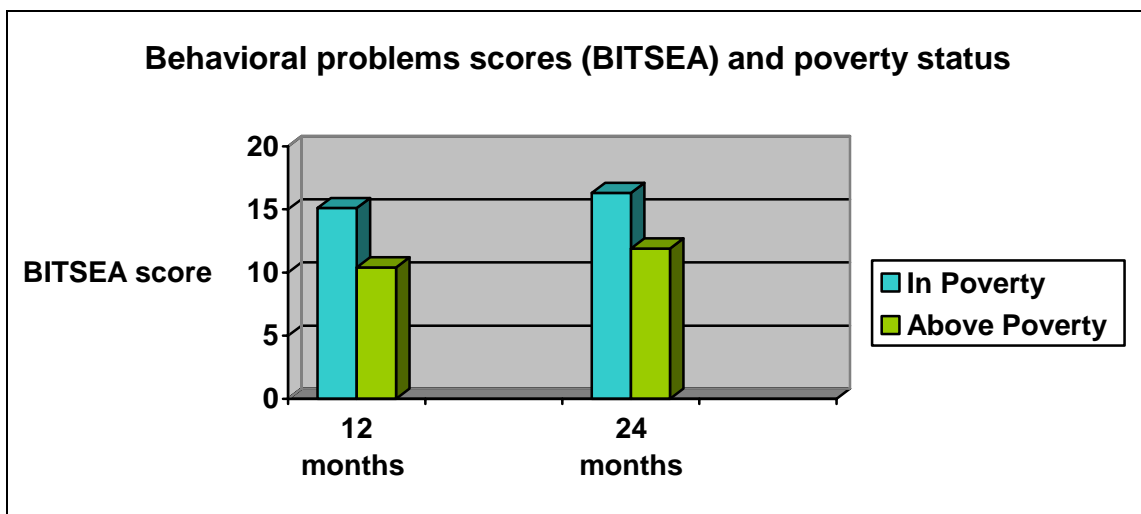
Research Question #2 (restated):

Are the effects of prematurity and poverty indirect, via their direct effects on parenting? To what degree does parenting matter in predicting socio-emotional outcomes in these infants?

126

Analyses revealed that there was no relationship between prematurity and these outcomes. Poverty did indeed seem to affect outcomes. Maternal sensitivity scores at four and twelve months were found to be highly correlated (Pearson r (127) = .54, p < .001). Due to the high correlation the scores from months four and twelve were averaged together to create the Year 1 maternal sensitivity score. It was found that maternal sensitivity was significantly associated with poverty status. (See Figure 3.)

Figure 3.
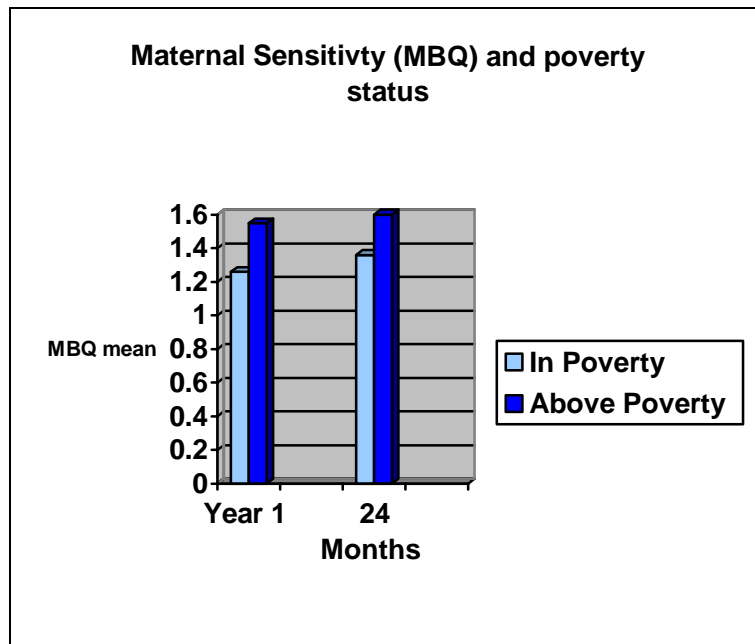
Maternal Sensitivty (MBQ) and poverty status

Year 1 maternal sensitivity was significantly associated with infant-mother attachment security at 12 and 24 months and with infant behavior problems at 12 months, but not with infant behavioral competencies. (See Table 1.)

Table 1.

Correlations between Year 1 Maternal Sensitivity, Infant attachment security and Behavior problems at 12 and 24 months				
	Attachment security		Behavior Problems	
	12 mos.	24 mos.	12 mos.	24 mos.
Maternal Sensitivity	.65***	.44***	-.19*	-.08
*** Significant at p < .001			*significant at p < .05	

127

24-month maternal sensitivity was significantly associated with infant-mother attachment security at 24 months, but not with infant behavior problems or behavioral competencies. (See Table 2.)

Table 2.

Correlations between Year 2 maternal sensitivity and infant attachment security and behavior problems at 24 months
Attachment security
24 mos.
Maternal Sensitivity   .67***
*** Significant at p < .001

Mediation Analyses

As previously indicated, poverty status, year 1 maternal sensitivity, and 12-month infant-mother attachment security were all intercorrelated. Thus, analyses were conducted to test the hypothesis that links between poverty and infant attachment security was mediated by maternal sensitivity.

These analyses followed recommendations by Baron and Kenny (1986) for testing mediation. Partial correlations were conducted, statistically controlling for maternal sensitivity, to determine if the association between poverty status and infant attachment security at 12 months remained significant. If, after statistically controlling for maternal sensitivity, the relation between poverty status and infant attachment security dropped to non-significance, it is likely that maternal sensitivity mediates the link between poverty and infant attachment security. If the link between poverty and infant attachment security remained significant, it means that poverty continued to influence infant attachment security independent of mother's behavior. A partial correlation, statistically controlling for maternal sensitivity, revealed that the link between poverty and 12-month infant attachment security was no longer significant. Thus, maternal sensitivity likely mediated the link between poverty status and 12-month infant attachment security (see Figure 4)

128

Figure 4.

Year 1 maternal sensitivity mediates the link between poverty status and 12-month infant attachment
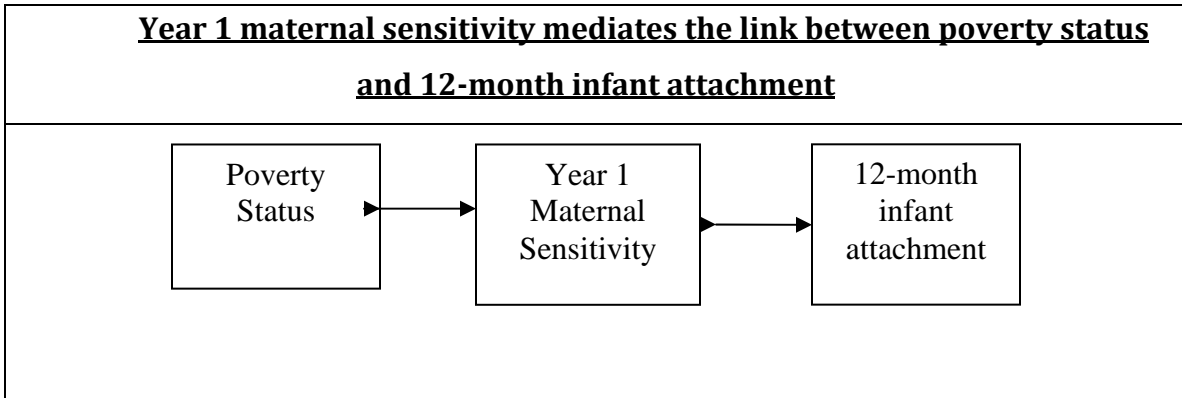
Another set of analyses were conducted to test the hypothesis that links between poverty and 24-month infant attachment security were mediated by maternal sensitivity. This analysis, however, did not support year 1 maternal sensitivity as a mediator. Poverty status continued to be significantly associated with infant attachment security at 24 months, even after statistically controlling for year 1 maternal sensitivity. (See Figure 5.)

Figure 5.

Year 1 maternal sensitivity does not mediate the link between poverty status and 24-month infant attachment
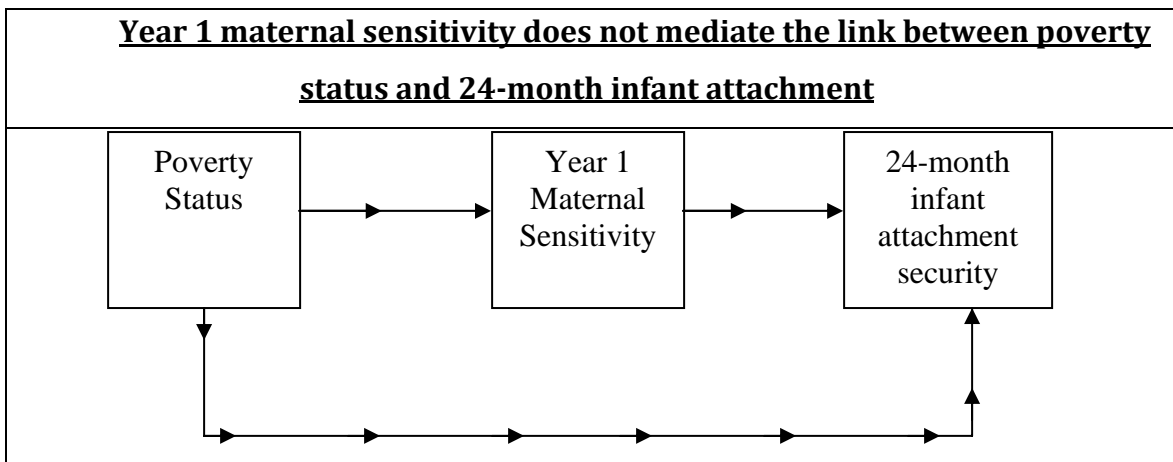
A similar mediation analyses found no support for Year 1 maternal sensitivity as a mediator of the link between poverty status and 12-month infant behavior problems. Another analyses looking at 24-month maternal sensitivity as a mediation of the link between poverty and 24-month infant attachment security, also found no support for maternal sensitivity as a mediator.

Research Question #3 (restated):

If parenting does matter, what predicts individual differences of parenting in poverty?

It was found that gestational age at birth affected parenting differences. The later

the child was born the more sensitive the mother was found to be. Another factor found to influence parenting was the presence of maternal depression. The more depressed the mother was the less sensitive she was to her child.

Discussion

Within this study, we have found that prematurity status did not seem to matter in predicting infant socio-emotional outcomes. Poverty status, on the other hand, did. This was proven true when maternal sensitivity did indeed act as a mediator between poverty and 12-month infant security of attachment but did not mediate this link when it came to 24-month infant security of attachment. By the time children reach two years of age, even though maternal sensitivity remained significantly associated with attachment security, poverty may continue to have an impact on children's attachment security because even very good mothers mothers may not be "good enough" to meet the basic needs of their infants. Evans (2004) states that "although the surroundings of low-income children contain more singular psychosocial and physical environmental risk factors with known adverse developmental outcomes, the confluence of multiple psychosocial and physical risk factors may be a key, unique feature of childhood poverty." (p.86) Evans is indicating the point we have just mentioned. No matter how good of a parent one may be the buildup of adverse situations and negative life events is a very difficult obstacle to triumph over. In addition, at 24-months, children are more cognitively aware of their surroundings and may become conscious of what is lacking in their environment.

The results that have been discussed in this study about maternal sensitivity and infant attachment security are consistent with many other studies in the field of attachment. Some notable works are that of Ainsworth (1979) , Coppola et al., (2007) and McElwain et al., (2006) to just name a few. These authors all analyze and discuss how maternal sensitivity and interactions with her child influences the quality and security of the attachment.

Poverty was also associated with increased behavioral problems at 12 and 24 months but not with behavioral competencies. Maternal sensitivity was also discovered to be greatly affected by the family's poverty status. Mothers in poverty were found to be less sensitive to their child's needs. Mothers may be less sensitive because they are preoccupied with finding the means to provide their family with the necessities and dealing with all of the other negative life experiences that they may be encountering. Certain aspects of life also influence parenting. Several bodies of work support this claim, McLoyd (1998) states that "overwhelming evidence exists that these parenting behaviors stem partly from an overabundance of negative life events and conditions that confront poor adults." (p.196) within the context of poverty, prematurity and maternal depression were each associated with mothers' behavior. Others have found similar results; Lovejoy (2000) analyzed depressed mothers and their interactions with their children. It was found that the association with positive maternal behavior was weak, for mothers with depression, but was strongly associated with negative maternal behavior. Another factor that influenced individual differences among parents in poverty was the gestational at birth of the infant. The later the gestational age of the infant the more sensitive, the mother was found to be to her child.

130

There are many intervention programs aimed to demonstrate how to be a good parent, to promote parental sensitivity and so on, but the parents in poverty need more. Interventions should focus as much on meeting basic needs as on promoting parenting. Parents in poverty need the guidance and assistance to acquire the skills and resources needed to ensure that their families will be provided with the necessities. Halpern (1990) states that:

> "The model that increasingly seems necessary for young families is one that provides a flexible mix of concrete, clinical, and supportive services in a nonbureaucratic, family-like context. It has to be a model that can work simultaneously and comfortably at multiple levels: from the immediacy of getting the heat back on in an unheated apartment to the gradual building of trust in a young adult whose life has been marked by a series of losses." (p. 15)

Scholars, such as Ramey et al, (1995), state that providing a concentrated intervention program, for families in poverty, primarily on gearing parents to become self-sufficient is not a good approach for improving child's development. In order for these interventions to be successful the program must (1) provide opportunities to explore and gather relevant and necessary information, (2) provide mentoring for the newly acquired skills, (3) celebrate each developmental achievement, (4) the review and rehearsal of the new skills and newly gained knowledge, (5) avoiding inappropriate punishment and ridicule, and (6) providing language supports for the individual. After these needs are met then the parental sensitivity promoting interventions will see greater results. In order for the parents to be ready and able to take on future endeavors with success, past and present troubles and obstacles must be addressed.

Many speak of the interventions aimed at and created for the parents, but one must not forgot how crucial an intervention, which is well designed and executed, can be to the development of a child. Programs, such as Head Start, are good but the effects are not long lasting and may not be good enough. Zigler (1994) proposes new plans for future action:

> "The net result of all of these efforts has been to shape a new approach to early intervention that embraces the consecutive stages of child development. We have come to realize that a year or two of preschool cannot turn children into geniuses or forever free them from poverty. Instead, we must give a long-term commitment to at-risk children throughout their growing years. The time between birth and age 3 is a period of rapid growth that lays the physical and socioemotional foundations for all later development, including the capacity to benefit from preschool." (p. 41)

Other beneficial types of interventions are ones that help promote and maintain secure attachment between mother/parent and child, these interventions provide the parents with information and exercises that they can apply when they are interacting with their child. Many offer helpful tips and services to help alleviate different stressors that may be effecting or hindering the development and preservation of the infant-mother

attachment. If these intervention programs are implemented, at an earlier time and for lengthier periods of time, then the effects of poverty may be curbed and many more children in poverty will have a better fighting chance for their future.

Acknowledgments

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