2003 AAPP Monograph Series

John McFadden  
*University of South Carolina - Columbia*, jmcfadde@mailbox.sc.edu

Brian L. Johnson  
*University of South Carolina - Columbia*

Christopher Leevy Johnson  
*University of South Carolina - Columbia*

Joyce D. Jackson  
*University of South Carolina - Columbia*

Kuo-chung Chang  
*University of South Carolina - Columbia*

*See next page for additional authors*

Follow this and additional works at: [https://scholarcommons.sc.edu/mcfadden_monographs](https://scholarcommons.sc.edu/mcfadden_monographs)

Part of the African American Studies Commons

**Recommended Citation**

[https://scholarcommons.sc.edu/mcfadden_monographs/7](https://scholarcommons.sc.edu/mcfadden_monographs/7)

This Book is brought to you by the Grace Jordan McFadden Professors Program at Scholar Commons. It has been accepted for inclusion in Monograph Series by an authorized administrator of Scholar Commons. For more information, please contact dillarda@mailbox.sc.edu.
AAPP Monograph Series
African American Professors Program

John McFadden, Ph.D.
Editor
University of South Carolina

2003
ACKNOWLEDGMENTS

The support that the African American Professors Program (AAPP) receives from the University of South Carolina, the W. K. Kellogg Foundation, and the South Carolina General Assembly is invaluable.

In addition to authors of chapters, their mentors, and editorial reviewers, the following persons contributed significantly toward the preparation of papers for publication of this monograph and are, therefore, acknowledged for their unique efforts of advice, reviewing, and literary support.

Marva J. Larrabee, Ed.D.
Grace Jordan McFadden, Ph.D.
Rhittie L. Gettone
James L. Moore, III, Ph.D.
Rashida H. McFadden
Andrea L. Stewart
Theophilus Sanga

It is appropriate to pay special tribute to Marva J. Larrabee for her countless hours and commitment in helping AAPP to produce this quality monograph.
# Table of Contents

Foreword .............................................. vii  
Preface ................................................... viii  
In Memoriam ........................................... x  

The Application of Stylistic Counseling on Historic Hilton Head Island ........................................... 1  
  
  John McFadden, Ph.D.  
  *The Benjamin Elijah Mays Professor*  
  *Director, African American Professors Program*  
  *University of South Carolina*

**PART 1: COLLEGE OF LIBERAL ARTS**

William Edward Burghardt Du Bois (1883-1934): Authorship, Reform Writing and Periodical-Based Leadership ................. 20  
  
  Brian L. Johnson, Ph.D.  
  *Department of English Language and Literature*  

Free Indeed: Resistance to Anglican Conversion in Colonial South Carolina ........................................... 32  
  
  Christopher Leevy Johnson  
  *Department of History*

**PART 2: MOORE SCHOOL OF BUSINESS**

E-Commerce and Corporate Strategy: A View from the Top ................................................................. 60  
  
  Joyce D. Jackson and Kuo-chung Chang  
  *Department of Management Science*

**PART 3: NORMAN J. ARNOLD SCHOOL OF PUBLIC HEALTH**

Matters of the Heart Among African American Women ................................................................. 72  
  
  Winifred W. Thompson, MSW  
  *Department of Health Promotion, Education, and Behavior*
PART 4: COLLEGE OF EDUCATION

A Comparison of Two Methods of Estimating Effect Size When Missing Data Are Present ..................84
Dorinda J. Gallant-Taylor
Department of Educational Psychology

Disability, Race, and Disproportionality ..............95
George Lee Johnson, Jr., M.Ed.
Department of Educational Psychology

PART 5: COLLEGE OF ENGINEERING AND INFORMATION TECHNOLOGY

Science You Can Understand: Nuclear Technology (Fission, Radiation, Power Plants, and Weapons) .......108
D. Samuel Duetsch
Department of Chemical Engineering

The AAPP Experience: A Personal Epilogue ............120
Sirena C. Hargrove-Leak
Department of Chemical Engineering

PART 6: COLLEGE OF PHARMACY

Stroke: A Review of the Disease State ..................128
Phyllis I. Perkins, Pharm.D.
Department of Pharmaceutical Health Outcomes Science

PART 7: COLLEGE OF SCIENCE AND MATHEMATICS

Investigating the Reducibility of Polynomials ............142
Dawn B. McNair
Department of Mathematics

Microhabitat Selection: Everybody Is Doing It ............152
Maxine Henry
Marine Science Program
FOREWORD

In 1993, Dr. Cornel West poses, in his highly acclaimed *Race Matters*, two fundamental questions to African Americans, "How do we account for the absence of the Frederick Douglasses, Sojourner Truths, Martin Luther King, Jrs., Malcolm Xs, and Fannie Lou Hamers in our time?" and "Why hasn't black America produced intellectuals of the caliber of W.E.B. Dubois, Anna Cooper, E. Franklin Frazier, Oliver Cox, and Ralph Ellison in the past few decades?" Thanks to Dr. West... these questions evoked, for me, many thoughts and feelings, which have stirred my academic interests as well as personal motivation to identify people and initiatives that attempt to produce African American men and women with the integrity and fortitude of Charles H. Houston, Benjamin E. Mays, Barbara Jordan as well as individuals with the intellect of the caliber of St. Clair Drake, Kenneth Clark, Zora Neal Hurston, and Alain Locke. The African American Professors Program at the University of South Carolina is one of these initiatives. This program is designed to produce the next generation of PhDs...a cadre of young, up and coming African American scholars, researchers, and academicians who can shoulder some of the burdens as well as some of the challenges in the Academy.

Dr. John McFadden, Director of the African American Professors Program and Benjamin Elijah Mays Professor, has assembled once again another talented pool of doctoral students to participate in the African American Professors Program as well as contribute their research and scholarly work to this year's *African American Professors Program Monograph Series*. This publication, like the first two monograph editions, reflects the depth and breadth of the doctoral students' research and scholarship in their respective disciplines (e.g., engineering, pharmacy, education, etc.), and it clearly illustrates the overall competence of the doctoral students in this year's African American Professors Program. I would like personally to congratulate Dr. John McFadden for doing an excellent job in developing the next generation of scholars, researchers, and academicians. It is clear that the doctoral students in this year's African American Professors Program are destined to become the "new" leaders, endowed chairs, and distinguish professors in the Academy around the world.

*James L. Moore III, Ph.D.*
Assistant Professor, Counselor Education
The Ohio State University
It is significant that the African American Professors Program (AAPP) at the University of South Carolina is producing the third edition of its annual monograph series at this time—the fifth anniversary of AAPP. The program graciously accepts the challenge of putting into place a requirement for the scholars to produce quality research papers worthy of publication. This provides widespread visibility for them and enhances their curriculum vitae concurrently.

Scholars who have contributed manuscripts for this monograph are to be commended for adding this additional responsibility to their academic workload. Writing across disciplines adds to the intellectual diversity of these papers. From neophytes, relatively speaking, to an array of very experienced individuals, the chapters have been researched and comprehensively written.

Founded in 1997 through the Department of Educational Leadership and Policies in the College of Education, AAPP was designed to address the underrepresentation of African American professors on college and university campuses. Its mission is to expand the pool of these professors in critical academic and research areas. Sponsored by the University of South Carolina, the W. K. Kellogg Foundation, and the South Carolina General Assembly, the program recruits students with bachelor’s, master’s, and doctoral degrees for disciplines in which African Americans currently are underrepresented.

An important component of the program is the mentoring experience that is provided. Each student is assigned to a mentor/professor who guides the student through a selected academic program and provides various learning experiences. When possible, the mentor serves as chair of the student’s doctoral committee. The mentor also provides opportunities for the student to team teach, conduct research, and co-author publications. Students have the advantage of attending committee, faculty, and professional meetings, as well as engaging in a range of activities that characterize professional life in academia. Scholars enrolled in the program also are involved in programmatic and institutional workshops, independent research, and program development.
The continuation of this monograph series is seen as responding to a window of opportunity to be sensitive to an academic expectation of graduates as they pursue career placement and, at the same time, one that allows for the dissemination of AAPP products to a broader community. The importance of this monograph series has been voiced by one of our 2002 AAPP graduates, Dr. Shundelle LaTjuan Dogan, a recent Harvard Administrative Fellow at Harvard University and now Program Officer for the Southern Education Foundation, Atlanta, Georgia. Dr. Dogan wrote:

“One thing in particular that I want to thank you for is having the African American Professors Program scholars publish articles for the monograph. I have to admit that writing the articles seemed like extra work at the time. However, in my recent interview process, organizations have asked me for samples of my writing. Including an article from a published monograph helped to make my portfolio much more impressive. You were “right on target” in having us do the monograph series.

We hope that you will read this monograph of the African American Professors Program with enthusiasm or enlightenment.

John McFadden, Ph.D.
The Benjamin Elijah Mays Professor
Director, African American Professors Program
University of South Carolina
IN MEMORIAM FOR PAUL P. FIDLER
AN AFRICAN AMERICAN PROFESSORS PROGRAM MENTOR

In light of the University of South Carolina College of Education's role in this intentional program to administer a program to create a future generation of African American college and university professors, it is appropriate that we recognize briefly the passing of one of the best of our African American Professors Program mentors, Dr. Paul P. Fidler. His life was one of commitment to many noble causes and especially to people. One such cause, at the top of his list, was the mentoring of future African American professors. His accomplishments and legacies enumerated had a profound impact on all types of USC students, including the University's African American student population. His career directly paralleled the same period of history during which the University was racially integrated and then moved to exceptional levels of accomplishment in sponsoring and achieving African American student graduation-attainment levels and broad aspects of achievement of leadership in the co-curriculum. The editor of this monograph urges especially our African American Professors Program scholars to consider how this man's life of service can serve as an exemplar for lives of service, which you can lead after the completion of your studies at the University.

While we maintain this man's life was one of unique service, we also believe that yours can and will be also.

Dr. Paul P. Fidler, Professor Emeritus of Higher Education of the University of South Carolina, died on June 22, 2003 in Boston, Massachusetts after losing his struggle with a long illness, which had previously led to his official retirement from the University on June 30, 1999. Fidler is remembered both at USC and in the larger national higher-education community for a number of very important accomplishments and the unassuming manner in which he performed them that far transcended his work on the Columbia campus.

Dr. Fidler, a native of Elkins, West Virginia, was raised in Beaufort, South Carolina, and he came to the University of South Carolina in 1961 on active duty with the U.S. Navy, stationed with the Naval ROTC department. Fidler received his
undergraduate education at Duke University, his master's degree from the University of South Carolina, and his doctorate from Florida State University.

Dr. Fidler held a variety of senior administrative posts over nearly four decades in the University's Division of Student Affairs. One of the numerous lasting contributions of Dr. Fidler's that influenced many, many thousands of USC students has been the University's highly acclaimed Career Center, which occupies an entire floor of the Columbia campus's Moore School of Business and serves the total undergraduate student body. Thanks to Fidler's original vision and recruitment of founding personnel, this center is the equal of any of the finest in the country and is truly a lasting legacy to his work for the State's college students.

In addition to his many appointments in the Division of Student Affairs, Paul Fidler also was an unceasing champion for meeting the needs of so-called "undeclared" students, those who enter college without having yet chosen a major field of study and those who often have special challenges fitting into large universities. He creatively designed services in a special experimental office to serve these students whose needs most often are unaddressed in large universities, which are focused around majors and special admission criteria for entering its internal structure of colleges and schools. Thus, over many years student personnel services at USC have addressed the needs of a great many special students who often would not have been successful completing their goals of a college education.

Fidler ultimately became the mainstay of both a master's and doctoral program in college student personnel services and the study of higher education offered through USC's College of Education. For nearly forty years these programs enabled USC to join a very select group of approximately 100 institutions actively engaged in the preparation of future higher-education leaders, including future college presidents. Fidler's graduates, numbering over a thousand, are now placed in positions of influence on campuses throughout the country, thus, vastly expanding the influence of USC in spreading its vision for how student-affairs professionals should be appropriately prepared.

While Fidler never taught USC's University 101 course or had any administrative responsibility for it, his research on its effectiveness was exemplary. His research had more influence than any other single factor in persuading University
leaders to make this concept a mainstay of the USC new-student experience and was instrumental in establishing USC as a leader in this growing national phenomenon in universities.

In the era of student protests during the late 1960s culminating in the USC student "riot" of May 1970, Fidler's name appears quite frequently in the University's archives for his roles as student advocate, counselor, mediator, and voice of calm reason in the heat of that period's anger, discord, and tumult. During this period, Fidler also was known as a champion for the special needs of African American students, who had been permitted only to attend the University since the middle 1960's. His role as advocate and mentor for African American students, including those participating in the African American Professors Program, was a consistent and dominant theme throughout his entire career.

We urge the future African American professors who may read this testimonial to reflect on what kind of legacies you would like to leave at the end of your career: How will your remaining and surviving colleagues write about your values and contributions? This is the time in your lives to go forward with a very intentional philosophy and commitment to achieve through unselfish mentoring, as this now deceased, but still very alive in memory, faculty colleague of ours accomplished in his life of service to students such as you, our reader. Your future students, our country, and your former professors such as Dr. Paul P. Fidler, deserve nothing less.

John N. Gardner
Distinguished Professor Emeritus
Senior Fellow
University of South Carolina at Columbia
July 31, 2003
THE APPLICATION OF STYLISTIC COUNSELING ON HISTORIC HILTON HEAD ISLAND

John McFadden, Ph.D.
Benjamin E. Mays Professor
Director, African American Professors Program
At the southern tip of the State of South Carolina is an island called Hilton Head. It is rich with natural beauty and is considered home by numerous individuals and families. For generations past, the only entry to Hilton Head from the mainland was by boat. In the late 1950’s, however, a bridge was constructed that connected Hilton Head to the mainland of Beaufort County, South Carolina. The bridge was feared by some and anxiously anticipated by others. Nevertheless, this new bridge contributed to turning Hilton Head into an island of accessibility and is now a part of the island’s indelible history.

Counselors in today’s society work with clients of a variety of cultures and backgrounds. The small island of Hilton Head itself contains residents of diverse cultures and histories. One aspect of this preservation is the maintenance of “Gullah”, a blend of slave, native cadence, and Elizabethan English (http://www.hiltonheadisland.com/history.htm). An objective of many counseling theories is to understand the client’s phenomenological view, allowing the counselor to comprehend and empathize with the client’s unique world through the client’s perceptions of that world. As we have begun the twenty-first century as a multicultural nation, it is imperative that counseling professionals make the time and commitment to gain further understanding into what aspects of their clients’ lives and cultures help to define their world as well as who they are individually. The stylistic model of counseling (McFadden, 1999) allows for greater depth and insight in the counseling relationship for both counselor and client. When used appropriately, stylistic counseling may help to serve as a bridge, connecting counselor and client, as well as client and culture, offering each counselee accessibility to both insight and possibility.

This chapter describes stylistic counseling and its principles for use, particularly, with clients of a diverse cultural setting, which is found on Hilton Head Island. A history of Hilton Head Island and select cultures that inhabit the island also is provided. The modality and techniques for stylistic counseling and present day Hilton Head are integrated in a discussion about approaches to provide effective counseling outcomes for a community of diverse peoples. The purpose of this
chapter is to offer readers an opportunity to examine an appropriate application of stylistic counseling to a set of potential clients who represent the unique cultures of Hilton Head Island.

**STYLISTIC MODEL**

“Culture” continues to be a term that contains a great deal of subjectivity in its definition. Culture has been defined by many in both broad and narrow terms. Because there is no completely universal definition for the term culture, as counselors, we must explore within ourselves and with our clients what aspects of life are incorporated in the term. For the purpose of this chapter, culture remains broadly defined in order to gain a greater understanding of the personal, physical, and sociopolitical factors of one’s background (McFadden, 1976). There are two dimensions to be considered when defining culture. Primary dimensions of culture include areas such as race, ethnicity, age, gender, sexual orientation, and physical abilities. Secondary dimensions of culture include areas such as income, religious beliefs, geographic location, education, marital and parental status, and military experience (Wehrly, 1995). A person’s culture embraces the primary and secondary dimensions along with his or her values, beliefs, and behaviors and can be stated in terms of what grounds an individual and reminds him or her of home.

It is to be understood that culture is inescapable for each of us. Each individual is defined by his or her culture, regardless of whether an individual has taken the time to explore the impact of culture on his or her identity. Much of the transcultural literature contends that it is important for a counselor to explore his or her own cultural identity prior to counseling individuals effectively who are of different cultural backgrounds and views of life (McFadden, 1993b).

Stylistic counseling, introduced in the early 1970’s, was designed as an approach to “improve cultural understanding” as well as to contribute to “our quest for focus and efficiency in meeting contemporary challenges” (McFadden, 1993a, p. 60). As counselors, we are challenged by a world in which certain cultures, “ethnic minority cultures” in America in particular, have been
oppressed throughout history. As these “ethnic minorities” also have been under­
represented systematically in both counseling literature and techniques, stylistic
counseling was developed in order to meet the needs of minority clients and to
understand the unique composition of each client’s background. One premise
underlying stylistic counseling is to understand the client at a deeper cultural and
historical level rather than addressing only the surface problems, which are the
focus of many other counseling techniques. This process of deeper understand­
ing involves reviewing several steps back from where most counseling models
begin in order to gain insight into the client’s culture and how that culture in
relationship with the world and its people has affected him or her. For decades,
stylistic counseling has proven to be an effective model of counseling not only for
“ethnic minorities” but also for people of various backgrounds and identities.
It serves as a basis for counselors to understand the ideology and practice
behind systemic marginalization experienced by their clients, and it sets the stage
for them to accept a role of social responsibility toward positive living
(McFadden, 2003). In general, stylistic counseling is intended to be used as an
eclectic model with opportunities for counseling professionals of differing theo­
retical orientations to broaden the cultural foundations from which they work.

The stylistic model of counseling (McFadden, 1999) is one that is both
cubical and hierarchical in nature. The stylistic cube, shown in Figure 1, is
comprised of three main dimensions: cultural-historical, psycho-social, and
scientific-ideological. Each of these three dimensions encompasses nine cubical
descriptors, which describe aspects of their respective dimensions. These
descriptors allow for the counselor to work from various aspects of each dimen­
sion with the client. As counselor and client gain insight and understanding of
one dimension, they are able to progress to the next. Figure 1 illustrates the
three basic dimensions of stylistic counseling. Table 1 lists the cubical descriptors
with their respective dimensions.

The basic dimension of this model is known as cultural-historical (C-H) and
represents the foundation for stylistic counseling. It is essential for counselors to
have intuitive and/or active insight into the culture and history of their clients.
Each of the nine cubical descriptors in this particular dimension has meaning for clients. From the cultural-historical dimension, counselors progress in a vertical or diagonal manner toward solving pressing dilemmas of their clients.

A second dimension for stylistic counseling is known as psycho-social (P-S). During this stage of counselor intervention, an opportunity exists for the counselor to understand the parameters of the psychological impact of client issues and, moreover, to see what social action prevails as the client reveals person-to-person dynamics of an ongoing nature. Cubical descriptors at this point both build on the C-H dimension and set the stage for the science and ideology of the layers of cubicals on the S-I dimension. The nine descriptors of the P-S dimension allows for exploration of the relationships between psychological security and sociological development of relationships (See Table 1).

**Figure 1. The Stylistic Counseling Cubic Framework.**
Table 1. The Descriptors for Each Dimension of the Stylistic Counseling Cube

<table>
<thead>
<tr>
<th>Cultural-Historical</th>
<th>Psycho-Social</th>
<th>Scientific-Ideological</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnic/Racial Isolation</td>
<td>Ethnic/Racial Identity</td>
<td>Ethnic/Racial Relations</td>
</tr>
<tr>
<td>Dynamics of Oppression</td>
<td>Psychological Security</td>
<td>Logic-Behavioral Chains</td>
</tr>
<tr>
<td>Value System</td>
<td>Self-Inspection</td>
<td>Individual Goals</td>
</tr>
<tr>
<td>Family Patterns</td>
<td>Personality Formation</td>
<td>Meaningful Alternatives</td>
</tr>
<tr>
<td>Monocultural Membership</td>
<td>Social Forces</td>
<td>Media Influences</td>
</tr>
<tr>
<td>Historical Movements</td>
<td>Mind Building</td>
<td>Politics</td>
</tr>
<tr>
<td>Cultural Traditions</td>
<td>Human Dignity</td>
<td>Economic Potency</td>
</tr>
<tr>
<td>Leaders and Heroes</td>
<td>Perception of Others</td>
<td>Relevant Programs</td>
</tr>
<tr>
<td>Language Patterns</td>
<td>Self-Development</td>
<td>Institutional Goals</td>
</tr>
</tbody>
</table>

The third dimension from which a counselor and client work is scientific-ideological (S-1). This dimension is transcended to by counselor and client only after effectively exploring the cultural-historical and psycho-social dimensions. The scientific-ideological dimension is the action and behavioral aspect of the stylistic model. It is within this dimension that the client is able to be empowered and function efficiently among a broad scope of cultural and sociological backgrounds while maintaining and understanding commitment to him or herself. The scientific-ideological dimension fosters what has been accomplished by the first two dimensions and manifests itself through client behavior (McFadden, 1999). The nine descriptors of this dimension also are listed in Table 1.

Stylistic counseling is efficacious through a commitment on the part of counselors to be well informed of a client's cultural background, the influential aspects of that background, and to ascend through the hierarchy of dimensions with the client. The eclecticism of stylistic counseling allows for the counselor to work through the ascension process, using techniques within his or her theory of choice, while focusing on the unique individual with whom (s)he is working. This model can be used with clients in each of the primary or secondary aspects.
of culture as presented and discussed in *Transcultural Counseling: Bilateral and International Perspectives* (McFadden, 1993b).

**A BRIEF HISTORY OF HILTON HEAD ISLAND**

Approximately 1.5 miles off of the Coast of Beaufort County, South Carolina lies Hilton Head Island. It is eleven miles long and five miles across at its widest point. Spanish moss decorates the tremendously large live-oak trees, and the distinctive low-country smell is due, in part, to a mixture of sea air, fragrant flowers, and marsh grass. The island is a place of magnificent beauty, but to have a clearer picture of Hilton Head it is necessary to review some aspects of its history. The concept of “going to the beach” for “natives” changed among several places including Hilton Head (Edgar, 1998, p. 579). Although the beauty of Hilton Head has remained over the years, the island and its people have experienced major changes (Leland, 1991).

Native Americans were the initial people known to inhabit Hilton Head. According to the Coastal Discovery Timeline (CDT) (Coastal Discovery Museum, 1998), archaeological digs have found evidence of Native American settlements dating to 1335 A.D. The CDT is the context from which all of the historical information on Hilton Head Island that follows was obtained. The CDT indicates that prior to the arrival of European explorers on the island in the 16th century, Native Americans fished, farmed, and hunted for survival on this southern sea island. The Native Americans’ first contact with European explorers was in the 1500’s when Spanish expeditions marked the beginning of colonization.

Hilton Head extracts its name from Captain William Hilton who sailed from Barbados to the island in 1663. Captain Hilton was sent from Barbados to explore lands granted by King Charles II. Almost twenty years after William Hilton’s voyage to the island, the Yemassee Indians began to move to the Hilton Head area. The Yemassee lived off the land and sea in relative isolation. However, in the early 1700’s European American (White) traders began moving to the area. After a great deal of abuse from the White traders and fearing possible enslavement, the Yemassee attacked several White settlements. Raids continued back and forth between the White man and the Yemassee for nearly fifteen years. In 1728, an
attack on White scouts by the Yemassee ended in a retaliation by White settlers, which forced almost all of the Yemassee out of South Carolina and into Florida. With this brutal retaliation, a population and culture on Hilton Head Island was regrettably ended.

The eighteenth century on Hilton Head Island marked the beginning of the Plantation Era. Indigo, rice, and cotton were grown on the island and sold for profit. Slave traders were traveling to West Africa, the Sierra Leone region in particular, in order to steal West Africans literally from their homeland and bring them to the Southern United States to work the plantations. The Sierra Leone natives were extremely knowledgeable about rice production, for it was a crop highly produced in their geographical area of the world. The slave traders intentionally took natives from this area because of their knowledge of the crop and a similar climate and stripped them of all that they possessed for profit and labor on Hilton Head plantations. While the profits of rice crops were increasing, the White population was decreasing. Due to the spread of tropical diseases such as yellow fever and malaria, many of the White plantation owners left the island for the majority of the crop’s year in order to live in places such as Savannah, Georgia and Charleston, South Carolina. The West African slaves were left to work the plantations for many months of the year under circumstances of geographical and sociological isolation. They began to incorporate their African history, heritage, and languages collectively to form a new culture. These West Africans, enslaved in South Carolina, became the roots of the Gullah culture, the only African culture with its own language still remaining in America today (Mitchell, 1998). Until the middle of the twentieth century, the Gullah dialect was considered to be “baby talk” that the slaves used to communicate with their masters. The “baby talk” theory, however, was misinformed, uneducated, and wrong. Upon their arrival to the United States, many of these slaves had “little or no acquaintance with the English language” (Turner, 1969, p 4). Gullah is actually a creolized form of English with surviving vocabulary of African languages, which are spoken in many areas of Africa such as Senegal, Gambia, Sierra Leone, Liberia, Nigeria, and Angola (Turner, 1969).
By the time that the Civil War broke out in the 1860's, the CDT (Coastal Discovery Museum, 1998) indicates there were over twenty working plantations on Hilton Head and its neighboring island of Daufuskie, which today is beginning to emerge with both social and economic popularity. Cotton, rice, and indigo production ceased on Hilton Head for the duration of the Civil War. In 1862, Hilton Head's population consisted of the enslaved, Union troops, prisoners of war, missionaries, and some civilian storekeepers. During this time the island's population reached over 40,000 people. The Civil War was raging while President Abraham Lincoln called for an experiment on Hilton Head, named the Port Royal Experiment, which was supervised by Rufus Saxton. This was an exploration to determine whether enslaved people in the colonies could benefit from an education in the event that the war would end and they might be freed. Thus, the town of Mitchelville was formed.

In Mitchelville, the prospectively freed slaves were able to obtain an education as well as to have their own town, streets, shops, elected officials, and economy. Mitchelville and the Port Royal Experiment provided the early Gullah community with an experience that was unique, unlike that in any of the other North American colonies. However, it was not until the Emancipation Proclamation and the Thirteenth Amendment in December of 1865 that the enslaved, newly-formed Gullah people were able to take their first step toward true freedom. Today, the only building still standing from the original Mitchelville site is the First African Baptist Church, which was formed in 1863 (Mitchell, 1998).

During the Civil War, the United States government bought many of the abandoned plantations. In the 1870's, some antebellum-plantation owners reclaimed their land after paying delinquent taxes that were charged to their property. Other property on Hilton Head was held by the government or sold either to freedmen, who remained on the island after the war, or to speculators from other places. Of the 24 postbellum plantations on Hilton Head, 15 contained Gullah-owned parcels (Mitchell, 1998). The island's plantations remained until the early 1900's when the boll weevil struck, destroying the plantation crops.

The Gullah people remained on Hilton Head after the Plantation Era. During
this time they comprised the majority of the island's population of approximately 300 persons. Many farmed land on the island, and some fished and operated oyster factories successfully until the 1950's when the oyster houses were closed due to pollution of the Savannah River from which they were harvested. During this period, Gullah people were again isolated on their island, living in a closely-knit community and simultaneously raising their families. Ferries containing goods and people were transported back and forth from the island to Savannah. For a time, the island was a place where needs for peace and solitude could be met for many native islanders (Heyward, 1998).

The 1950's would later prove to be a time that subsequently would bring extreme changes to the island forever. In 1956, a White man named Charles Fraser began buying land on the south end of the island in order to begin his plan of development. Fraser's ideas for development would later be known as Sea Pines Plantation. Today, Sea Pines is the home to Harbor Town and the most concentrated area of tourists visiting the island. It was also in 1956 that the James Byrnes Bridge was opened, a two-lane swing bridge that would allow automobile traffic to travel back and forth from the mainland to the island. According to the CDT, the island and the Gullah people were no longer in isolation. The Byrnes Bridge and the growing development in Sea Pines marked the beginning of what Hilton Head is known for today. Tourists and families began coming to the island for vacations in large numbers, and in 1960, when the first golf course opened on the island, they began traveling to Hilton Head to golf.

Although the development of Hilton Head as a resort island began in the late 1950's, it was not until 1975 that the first integrated elementary school was built for both Black and White children to attend. Land on Hilton Head was becoming increasingly more expensive at this time, and the wealthy were buying lots in order to build and develop anywhere they could. Along with the rising cost of property on Hilton Head came rising property taxes.

Many of the Gullah people who had owned land on the island for years could not afford to pay the ever-increasing property taxes. The wealthy would offer families on this land a sum of money to buy their property in order to save them the
burden of losing their land to the government or paying the outrageous property taxes. However, while saving the property tax, the Gullah people were losing their homes, land, and a part of their history. Many farms owned and worked by the Gullah people for the first half of the twentieth century were turned into golf courses, factory-outlet stores, and private, fenced residential communities still to be known today as plantations. Hilton Head was becoming a place where one could no longer go anywhere he or she pleased without a pass to get through a private gate. With plans of eventually returning to the island, some of the Gullah people moved north to search for jobs and greater opportunities than the island was providing. Some of the Gullah people remained on the island to hold tightly to their property and the place that they knew as home.

Today, over one million tourists visit the island each year, and a large portion of the island's population consists of "transplants," people who have moved to Hilton Head from other parts of the United States such as Ohio and New York, as well as from countries representative of the growing Latino population. A special census of Hilton Head taken in 1996 revealed that the full-time residential population of the island was 28,800 people. At the time that the census was taken, approximately 88.7% of the population was White (European American), 9.2% of the population was Black (African American), and 4.2% of the population was Latino (Spanish descendant). From 1990 to 1996, the Black population on Hilton Head decreased approximately 9.2%, and the Latino population increased 3.9% (Steve Hayward, personal communication, November 24, 1998).

Hilton Head's Latino population is continuing to increase annually. Although 80% of the Latino community is comprised of Mexicans, there are several other countries represented in this community: Guatemala, Honduras, Costa Rica, Colombia, Venezuela, Ecuador, Peru, Argentina, Bolivia and Puerto Rico (A. Hernandez, personal communication, October 30, 1998). According to Hernandez, with the saturation of development on the island in the last decade, Latinos are moving to Hilton Head primarily to work. Many Latinos are on the island temporarily in order to save money and plan to return home to their native countries.

Hilton Head is becoming more diverse in its residents each year. It is a com-
munity toward which some welcome its extreme developmental progress, and others fear that the progress of Hilton Head will detract from its natural beauty and solitude, destroying what the island itself has to offer. Nonetheless, when working with the people on this Southern Sea Island, one must take into account how rapidly change has occurred here over the past fifty years. The changes on Hilton Head affect all of its inhabitants, some more than others. When viewing this from a counseling perspective at the present and toward the future, it behooves one to connect with the island’s people and with its past in order to learn not only how the people affect the island but also how the island has affected the people.

INTEGRATION OF CONCEPTS

The stylistic model of counseling is designed to be used eclectically and works very well with family systems. The systemic principle of circular causality can be viewed through the hierarchical nature of the stylistic cubical descriptors (McFadden, 1999). The idea of working systemically with a client not only as an individual, but also as part of a family, work, and/or community-based system, is encompassed in the stylistic model of exploring the relationship with self and others. Prior to working with a client from any cultural background, it is imperative that the counselor focus on that client and his or her experiences as being unique. When working through this phenomenological point of view, it is important to remain subject to the client’s world and not to assume stereotypes that the counselor may believe about a client of a particular culture and background.

Hilton Head has become one of the most popular resort islands in the United States, and, as it has changed over the years, so has its cultural composition. Today, the island is a unique place of acculturation, integration, and segregation. Diversity lies within the residential cultures of the island, and, at the same time, island residents share some commonalities in living on the island itself. Because Hilton Head is a resort island, full-time residents are faced with the tourist season each year. One must realize that this is an aspect of every resident’s life. Hilton Head is more than just another resort or a growing town by the sea. She is a lady of the past, a lady who is beautiful, sometimes sinful, and sometimes controversial.
Tourism accounts currently for the majority of the island's economy, and, during the peak summer months of the season, the island's occupancy nearly doubles that of the standard residential population. Traffic problems, crowds, humidity, and heat are aspects that islanders generally face. Tourism also brings heavy service industry to the island. For many, professional jobs are difficult to come by on the island, and the turnover employment rate within hotels and restaurants is extremely high. Hilton Head has become a transient place in which people often have to struggle through the winter months to survive financially. Many residents of Beaufort and Jasper counties travel to the island to work but cannot afford financially to live on Hilton Head. This resort has become a community in which people must cater to tourists who bring money to a place that the residents call home.

As a counselor or some other helping professional on Hilton Head, it is important to be aware of commonalities and differences between counselor and client. Counseling should be an option to all residents of Hilton Head. Furthermore, though the majority of those seeking services may be European Americans, the focus of this manuscript for counseling purposes is the African American and Latino populations of Hilton Head Island.

When working with an African American client through the stylistic counseling model, one must begin at the cultural-historical level and seek to understand the unique history of each client. One of the initial ideas to explore at this level is whether the client is a native of the island or has migrated there from another location. While concentration in this chapter focuses on the native Gullah culture of the island, so are the following thoughts and questions. Beginning at the cultural-historical level, consider the dynamics of oppression that the client has faced while growing up in this geographical area. Has the client dealt with the struggle of retaining family land on a rapidly-developing island? What types of educational and job-related opportunities have been afforded or denied this client? We know that if the client attended elementary school on the island prior to 1975, (s)he was educated in a segregated setting. How aware is the client of his or her family history on the island, and in what ways has that awareness affected the client?
Many residents can trace their history to Mitchelville and even prior to that time. Explore the ways that (s)he has been affected by prejudice and discrimination on the island. In what ways has the client been segregated socially and economically from the development and profit of the island? How comfortable is the client working with a counselor who is culturally different from him/her? Explore the client’s family-value system. To what extent do the extended family and church play a role in the client’s life? It may be of great value to both client and counselor to include extended-family members and church members in sessions. How has the family adapted to the numerous changes on the island? To what extent does the client identify with the Gullah culture? If the client speaks with a Gullah dialect, (s)he has most likely faced prejudice due to people outside the Gullah culture having difficulty in understanding what (s)he is saying. To what extent does the client feel that (s)he is acculturated to the “new” Hilton Head, and what level of resentment, frustration, adaptation, or pride has come from that acculturation?

While working with a client at the psycho-social level, aspects of self-identity and relationships are explored. How does the client not only perceive Gullah culture but also him or herself as a unique part of that culture? To what extent does the client feel isolation between his or her culture and what is considered by many as “mainstream” on the island? In what areas of life does the client feel accomplished, and how can those accomplishments add to dignity and confidence of the client? How has the client been affected directly and indirectly through tourism, unemployment, and day-to-day relations with others? If the client works in the service industry, (s)he will have the responsibility of serving people from various parts of the globe. The ways in which this client is treated on a daily basis could have a great impact on his or her psychological well being. What is the client’s perception of other island residents, and are there existing relationships with those outside the Gullah culture? Systemically explore through cognitive, affective, and behavioral aspects the various ways in which the client could provide emotionally for him or herself and the systems of which (s)he is a part.

When working at the scientific-ideological level, the counselor is supporting the client in behavioral ways of accomplishing various goals. For a Gullah client
this might be achieved through becoming actively involved in the community through education. One might aspire to work with the community to preserve the Gullah language and heritage by telling Gullah stories at the local library or other oral modalities. Accomplishment of goals suggests becoming involved politically or simply being able to function in the community with inherent pride in oneself. One may aspire to work through the church to organize cultural dinners in which other island churches are invited to attend and share cultural dialogue.

When working with the Latino population, the areas and questions formerly explored in this manuscript should be aspects of focus with consideration for each client of his or her particular culture as being unique, with special consideration for the primary language of a Latino client. It is imperative for successful counseling outcomes that counselor and client are able to communicate effectively through language. As Aida Hernandez (1998), a Hilton Head resident, expressed during an interview, it is difficult enough to convey what one is feeling and thinking in one’s native language, not to mention a second or newly acquired language. In order for a counselor to work effectively with a Spanish-speaking client, the counselor should not only speak but also have a real command of the Spanish language (A. Hernandez, personal communication, October 30, 1998).

As a counselor functioning from the cultural-historical level, one must investigate each client’s unique history and heritage. Although Spanish-speaking cultures may share some of the same values and beliefs, one must remember that the Latino population on Hilton Head Island is represented by about 10 countries, each having a cultural history and heritage unique to that particular nation and client. Because the Latino population is generally new to Hilton Head, the counselor should explore the level of acculturation of each client initially. What struggles has the client faced in terms of prejudice and oppression since coming to Hilton Head? Has the client faced discrimination due to language barriers or cultural differences? How do the client’s family values differ from others on Hilton Head, and how is tradition passed from generation to generation (McFadden and Harper, 2003)? Does the client feel comfortable having relationships with people outside the Latino population?
At the psycho-social level, the counselor should explore what it means to the client's family for that individual to live on Hilton Head. A portion of the Latino population is working on the island because of employment opportunities due to extensive development of the island, while they plan to return eventually to their native countries. However, in many cases there are men on Hilton Head whose families remain in their country of origin. The counselor and client must take into consideration the depression and hardship involved for these men who are far away from family and loved ones. The counselor should explore how social forces on the island affect a perception of self and others for the Latino client. How does the client perceive him or herself when in situations outside of the Latino community? To what extent has the client been expected to assimilate in “American” culture? To what extent does the client feel supported by other members of the community? Extended family and church may play an important role in the life of a Latino client, and members of these systems may be of great importance to these clients.

When both client and counselor reach the scientific-ideological level of the stylistic counseling model, it will be important for the counselor to clarify and support the client's chosen goals. This may involve the clients being involved in the community through teaching Spanish or taking English classes. It is important for counselors to know facts such as St. Francis by the Sea, a local Hilton Head Catholic Church, has mass conducted in Spanish, allowing individuals who comprise the Spanish speaking population to integrate a part of their culture and worship through their native tongue. Counselors also need to focus on these questions: What choices and decisions have been successful for the client thus far; and in what way can those accomplishments be meaningfully recognized by the client? The behavioral aspect may include challenging local political institutions or working toward attaining higher wages for the services that the client provides at work. Many Latinos on Hilton Head work outdoors for construction and landscaping companies. Although, as a culture, their strong work ethic has proven to transfer to their work on the island, they are still paid minimal wages for their efforts. This work orientation, nevertheless, is maintained by Latinos and has implications for counseling interviews.
CONCLUSION

In applying the stylistic model of counseling to the African American and Latino populations of Hilton Head Island, it is important to reiterate the fact that first and foremost each client needs to be seen as a unique individual. Just as each counselor has history and experiences that make him or her like no one else, so does each and every client with whom that counselor interacts. While learning to work cross-culturally, one must balance factual information acquired through books and other materials with the relationship and knowledge of the individual client. It is easy and dangerous in cross-cultural situations to stereotype; however, when the counselor uses the stylistic counseling model in the manner in which it was designed, the counselor and client can avoid over generalizations, helping to make therapy effective and transcultural (McFadden, 1999). So, the future application of this unique framework for counseling provides hope for residents of Hilton Head Island with particular emphasis on African Americans and Latinos in a more socially responsible society.

REFERENCES


PART 1: COLLEGE OF LIBERAL ARTS
WILLIAM EDWARD BURGHARDT DU BOISE
(1883-1934): AUTHORSHIP, REFORM
WRITING AND PERIODICAL-BASED
LEADERSHIP

Brian L. Johnson, Ph.D.
Department of English Language and Literature
College of Liberal Arts

Situating African American scholars as authors has a rather long historiographical tradition in African American studies. Since Harold Cruse's enduring and pointed analysis of African American intellectuals and scholars, contemporary African American scholars (e.g., John Hope Franklin, Michael Eric Dyson, Henry Louis Gates, Jr., Cornel West, bell hooks, Hortense Spillers & Nathan Hare) also have commented upon a separate and distinct tradition of African American scholars as writers. Among their commentaries, Cornel West's "The Dilemma of the Negro Intellectual" draws the clearest link between African American scholarship and authorship. Sharing Cruse's recognition of African American scholars' dual commitments to their professional occupations and larger ethnic communities, West describes their dilemma thus: "...black intellectuals have little choice: either continued intellectual lethargy on the edges of the academy and literate subcultures unnoticed by the black community, or insurgent creative activity on the margins of the mainstream ensconced within bludgeoning new infrastructures." Although West's observations point to creating future possibilities for uniting African American scholarship and authorship for larger communal purposes, the suggestion also provides a rather remarkable opportunity for history of the scholars who wrote books to look retrospectively at the ways in which the most prominent African American scholar engaged in an unconventional form of print authorship to impact African American readership.

Robert Darnton's seminal articulation of history of the book studies in "What is the History of Books?" has provided the framework for such a task. By
arguing that history of the book's purpose is to concern itself with how a book "comes into being and spread[s] through society," Damron allows history of the book scholars to unearth and contemplate varying forms of African American print authorship to make manifest an intellectual tradition not unlike American literature. Elizabeth McHenry's *Forgotten Readers: Recovering the Lost History of African American Literary Societies* (2002) is one of the first studies to apply what Damron describes to African American literature. McHenry's project uncovers a "lost history" relating to nineteenth-century African American reading and writing practices. In doing so, McHenry's project applies book history scholarship to the assumption shared by "students of African American literature, history and culture" that viable sources of African American intellectual print production have been rendered "historically invisible" because of the academic tendency "to push aside facts surrounding other [African American] language usages—especially those related to reading and writing." The *Forgotten Readers' significance is that it widens what scholars have normally considered as "insurgent creative [print] activity" in African American social, cultural and literary history. This monograph chapter shares McHenry's assumptions and goals—along with history of the book's evolving methodological considerations—but also presses in the opposite direction.

This chapter, "William Edward Burghardt Du Bois (1883-1934)—Authorship, Reform Writing and Periodical-Based Leadership," recognizes that Damron's "communications circuit" need not only consider how a text "comes into being" and "spread[s] through society" but also the utility of that text. Similar to Michael Warner's history of the book analysis, *The Letters of the Republic* (1990), which has a chapter examining Benjamin Franklin's reliance upon varying print media to make manifest a republican eighteenth-century authorship, this project imaginatively considers how W.E.B. Du Bois utilized a specific form of print—magazine and newspaper periodicals—to bring a more utilitarian sense of authorship "into being" and "spread[s] through[out] society." In many ways, Du Bois's periodical-writing career can be equated to Warner's discussion of the beginnings of late-seventeenth and early-eighteenth-century
American public authorship. Warner suggests: "The exemplary case of the public sphere is the daily practice of religion ...." In similar fashion, Du Bois's periodical writings between 1883 and 1934 communicated his personal observations about African American moral and religious behavior, and though they are similar in utility to the earliest American writings, African American literature scholars have missed the opportunity to analyze this significant aspect of Du Bois's authorship. Although History-of-the-Book scholarship finally allows us to do so—though on a scale much smaller than Warner's or McHenry's study—this project is chiefly concerned with making the whole of Du Bois's authorship more "visible" by uncovering an unheralded set of his reform writings appearing in periodicals.

William Edward Burghardt Du Bois's sizeable record of periodical writings in African American letters has long been ignored in African American literary history. Du Bois's extensive authorship included 20 single-authored books, 33 pamphlets, 19 edited books and 58 edited studies; yet 2000 of his periodical writings—particularly those appearing in Crisis Magazine: A Record of the Darker Races, the place of Du Bois's most prolific periodical record—have gone virtually unstudied in African American literature, although they were clearly his preferred genre and also demonstrated a distinct type of authorship. The book historian Susanna Ashton has a forthcoming book that addresses African American periodical writers—including Du Bois's periodical work within the pages of Horizon (a periodical Du Bois edited briefly between 1907 and 1910)—but no published book-length project in literary studies is devoted to assessing the significance of the periodical in Du Bois's long career as an author. While Ashton's project is sure to provide an invaluable contribution to any future consideration of Du Bois's periodical authorship, it is not designed to offer an extensive deliberation about a periodical career ranging eighty years—dating from his first periodical efforts as a fifteen-year old in Great Barrington, Massachusetts, writing for the New York Globe in 1883, to his last periodical writing appearing on August 22, 1963 (five days before his death), in the The Pittsburgh Courier. Though the present study does not aspire to cover this enormous scope, it does offer a far more protracted
consideration than Ashton’s or anyone else’s because it covers Du Bois’s periodical career between 1883 and 1934—highlighting his most uninterrupted site of periodical authorship at Crisis from 1910 to 1934.

To be sure, African American periodical writing—especially Du Bois’s career as a periodical writer—is hardly a novel conception. Historians already have described Du Bois’s use of the periodical to commingle his scholarly vocation as a sociologist and his activist concerns into “scholastic activism.” Du Bois wrote in a long periodical-writing tradition, which includes African American intellectual and cultural icons such as Frederick Douglass, Pauline Hopkins, Ida B. Wells and Monroe Trotter; however, they used the periodical primarily to promulgate abolitionist and racial-protest rhetoric. Penelope Bullock’s The Afro-American Periodical Press (1981) describes this tradition’s genesis: “The overall development of the Afro-American periodical press was influenced by the status of Negroes in American society during the years between 1838-1909. This press began in the 1830s as a part of the organized activities of black people who were working for the emancipation of the slave and for the liberation of the free Negro from inequities and restrictions.” In spite of this more widely recognized tradition, Du Bois’s status as an African American scholar, appearing within the pages of periodical publications, was much more than “[…] a career as a scientist swallowed up in the role of master of propaganda.” Du Bois’s periodical writings—partly due to his academic background in sociology—existed within a “forgotten” stream of late-nineteenth and early-twentieth-century African American reform writing. Donald Franklin Joyce’s “Reflections on the Changing Publishing Objectives of Secular Black Book Publishers, 1900-1986” provides a useful framework for considering late-nineteenth and early twentieth-century African American reform writing. Joyce suggests:

[… ] black book publishers have seldom published books that might be classified as escape reading. Books published by black publishers have been and continue to be utilitarian, in the sense that they foster moral, social or practical values. Since the early
years of the twentieth-century, when black secular book publishing began to flourish in a meager way, the objectives of black secular publishers have involved satisfying definite intellectual and cultural needs within the black community. Often these needs reflected the reaction of blacks to the larger society's hostility or indifference toward the black community. In other instances the needs arose from changes within the black community.11

Although Joyce's study is primarily concerned with twentieth-century secular African American book publishers and their principal motivations, his commentary provides two powerful ideas for a broader consideration of African American authorship in general. Joyce insightfully recognizes a "utilitarian" tradition of African American writing, appropriately distinguishing it from most contemporaneous White writing, and his comments speak to a tradition of African American writing that was not singularly devoted to protest. Since Maria W. Stewart's *Productions of Maria W. Stewart* (1835)—perhaps the first compilation of African American reform essays, which included essays like "Religion and the Pure Principles of Morality, the Sure Foundation on Which We Must Build"—a significant number of late-nineteenth and early-twentieth-century African American writers also have written in a variety of genres to provide reform commentary to African American community members. In a rather curious moment in African American letters, W.E.B. Du Bois and Booker T. Washington approved a book containing their speeches, entitled *The Negro in the South: His Economic Progress in Relation to His Moral and Religious Development* (1907). Du Bois and Washington—along with other African American intellectual figures such as Alexander Crummell, Frances Grimke, Archibald Grimke, T. Thomas Fortune, Paul Laurence Dunbar, Anna Julia Cooper, James Corrothers, Hubert H. Harrison, William Hannibal Thomas and Charles Chesnutt—used either speeches, essays, sermons, fiction, autobiography, journalism or organizational activities to help remedy African American moral deficiencies because it was one of the most pressing concerns in the post-slavery south and the early twentieth century.12 Kevin Gaines speculates about the reformers' motivation:
“Against the Post-Reconstruction assault on black citizenship and humanity, black ministers, intellectuals, journalists and reformers sought to refute the view that African-Americans [...] could not be completely assimilated into American society.” Although the writings and activities of secular African American reformers are more widely noted, it was the local black minister—due to his longstanding presence in the institutional life of black churches and black religious organizations—who was the African American community’s best-known leader in moral-reform matters.

Eddie S. Glaude, Jr., in *Exodus!: Religion, Race and Nation in Early Nineteenth-Century Black America* (2000), argues that nineteenth-century Black churches and Black religious organizations focused almost exclusively on issues of moral reform. Black religious organizations such as the American Moral Reform Society believed that moral reform was the best “strategy for the improvement of all human beings regardless of complexional distinctions.” Noting what other historians like E. Franklin Frazier, C. Eric Lincoln, Carter G. Woodson, Benjamin Mays and Joseph Washington have already observed, Glaude explains that Black churches and religious organizations “circumscribed social activity and provided vocabularies for moral and ethical judgments” for the African American community. In many ways, this “vocabulary” was precisely what a more scholarly reformer like W.E.B. Du Bois hoped to offer an alternative to when writing in periodicals during the late-nineteenth and early-twentieth century. Unlike much of the dogma and didacticism associated with late-nineteenth and early-twentieth-century Black churches and religious organizations, Du Bois insisted that an absence of education contributed to most of the immoral and unethical behavior in the larger African American community. African American churches and religious organizations had as their reform pretext—mirroring sermons pronounced from its pulpits—a vague religious dogma that did not provide the kind of practical instruction that Du Bois’s sociological background offered. Reverend Crawford Jackson of Atlanta, Georgia, typified the late-nineteenth-century reform ideals of most Black churches and religious organizations when speaking at the Negro Young People’s Christian and Educational Congress held August 6-11, 1902: “We
want our [reform] movement to be Christian to the core. If God the Father through Christ is not to be its very Alpha and Omega, then I must be counted out.”

Du Bois disagreed with this reform ideology, arguing that dogma alone could not eradicate contemporary social problems that derived from slavery. Instead, he believed African Americans needed a firm historical and sociological grasp of a distinct African American phenomenon that Black ministers could not offer due to an insufficient educational background. Du Bois believed that such anti-intellectual positioning by Black ministers played a crucial role in crippling the holistic development of African American citizens. When Du Bois suggested that “a moral question” is nothing “more than a psychological and social question; and above all a field where our churches should get busy,” Du Bois effectively likened African American moral concerns to a sociological field of activity; for Du Bois, this provided grounds for reform writings appearing in periodicals that his scholarly occupation uniquely qualified him to offer.

Manning Marable is one of the few commentators to mark this persistent theme in Du Bois’s writings. Marable proposes, in W.E.B. Du Bois: Black Radical Democrat (1986), “culture and ethics rather than politics dominated Du Bois’s concerns.” African American cultural studies scholar, Karla Holloway, provides a helpful definition for the nominative term “ethics.” In Codes of Conduct: Race, Ethics, and the Color of Our Character (1995), Holloway suggests “ethics practices a moral imperative that is subject to narratives of community and culture.” To Du Bois—whose sociological studies on African Americans were the first to document social problems with systemic roots in immoral and unethical behavior—“ethical practices” in late-nineteenth-century and early-twentieth-century African American communities were faulty because their “moral imperatives” were shaped by primitive-religious beliefs that omitted advanced liberal-arts education and training. In “Of the Faith of the Fathers,” an essay appearing in The Souls of Black Folk (1903), Du Bois writes:

This deep religious fatalism, painted so beautifully in “Uncle Tom,” came soon to breed, as all fatalistic faiths will, the sensu-
alist side by side with the martyr. Under the lax moral life of the plantation, where marriage was a farce, laziness a virtue, and property a theft, a religion of resignation and submission degenerated easily, in less strenuous minds, into a philosophy of indulgence and crime. Many of the worst characteristics of the Negro masses of today had their seed in this period of the slave’s ethical growth. Here it was that the Home was ruined under the very shadow of the Church, white and black; here habits of shiftlessness took root, and sullen hopelessness replaced hopeful strife.  

Although Black churches and religious organizations were historically recognized as the African American community’s salient leaders, Du Bois found these groups to be largely ineffective when addressing persistent African American social problems that were rooted in immoral and unethical behavior. Du Bois believed that their refusal to rely upon liberal-arts training to prepare for an increasingly civilized American culture necessarily limited African American moral and ethical possibilities in an advancing modern age. The periodical became Du Bois’s point of entry into tightfisted southern—and primarily religious—African American communities in the late 19th and early 20th century. African American preachers had their wooden pulpits, and with the periodical, Du Bois had his paper pulpit; in effect, the periodical was the most expedient and most widely accessible means of communicating clipped knowledge for reform purposes as he envisioned it.  

With the exception of Marable’s commentary and Kevin Gaines’s *Uplifting the Race* (1996), very little has been written in either historical or literary studies about Du Bois’s desires to reform immoral and unethical behavior within the African American community. Kevin Gaines’s history calls Du Bois’s reform writings “racial uplift,” which Gaines suggests was part of an early 20th century, African American middle-class anxiety fueled by White societal expectations. Gaines’s work bases its case upon Du Bois’s moralizing sociological study, *The Philadelphia Negro* (1899), which was the first sociological study describing social conditions within an African American urban community. Gaines discusses
Du Bois's work alongside that of other Negro social leaders of the period. Although Gaines's work uncovers a grossly overlooked subject in Du Bois's writings, his history fails to examine Du Bois's most frequently used genre for reform writing. To be certain, Gaines uses some of Du Bois's periodical writings to supplement his commentary upon *The Philadelphia Negro*. However, by neglecting to distinctly examine the primary site of Du Bois's reform writings—thus ignoring a genre significantly different from his academic publications—he fails to fully explain Du Bois's complete configuration of reform authorship, which most frequently appeared at the site of periodical publication before and after (and not primarily in) *The Philadelphia Negro*. The fact that Du Bois's reform writings appeared in periodicals may even make a stronger case for the term "moral and ethical reform" rather than "uplift." (This also problematizes Gaines's suggestion that Du Bois's writings were fueled by White societal expectations.) The proximity between late-19th-century and early-20th-century African American moral and ethical practices and the ministerial leadership of its dominant moral institutions—Black churches and religious organizations—was such that it was difficult for Du Bois to introduce his reform writings into the public arena without intruding upon or contending with the reform work of these institutions. In keeping with Holloway's definition, Du Bois believed late-19th-century and early-20th-century immoral and unethical practices among African Americans were due to moral imperatives shaped by the narratives of uneducated Black-ministerial leadership.

In the main, the periodical provided Du Bois's scholarly opinion on African American reform matters—prior to that time, a discourse generally reserved for ministers in Black churches and religious organizations—a public sphere of influence. Du Bois innovatively used a form of print authorship to reform late-19th-century and early-20th-century African American citizens who represented those affected by social problems rooted in immoral and unethical behavior. This periodical-based leadership offered a platform where an alternative to the anti-intellectual leadership of Black churches might be communicated. Du Bois's use of the periodical for providing a more scholarly alternative to the leadership of Negro churches and religious organizations in reform matters evolved over three
pivotal phases between 1883 and 1934. In each of the periodicals he communicated through during these three phases, Du Bois relied upon his uncommon academic background as the basis for a periodical-based leadership for reforming immoral and unethical behavior in the African American community.

Du Bois's employment of periodical-based reform can be traced to his New England Congregationalist experiences and his first periodical writings as a teenage Great Barrington correspondent at Thomas Fortune's *New York Globe* (1883-1885). It was during those years that Du Bois sought to reform Great Barrington's African American citizens. Du Bois possessed the advantage of New England common-school training, and he followed Fortune's model for African American public writing. Du Bois's earliest reform writings were intended for a newly transplanted group of religious Black citizens from the south.

Additionally, as a newly graduated Ph.D. from Harvard, Du Bois became a proponent of Alexander Crummell's desire to provide educated and scholarly leadership in African American reform matters as an alternative to that which came from the uneducated African American ministry. Encouraged by his connection within Crummell's *The American Negro Academy* (1897-1903) and its *Occasional Papers*—a utilitarian periodical designed to transmit this leadership—Du Bois used his growing national reputation as a scholar to secure opportunities to publish these more inoffensive writings in progressive and religious White periodicals. These reform writings, which were some of Du Bois's earliest ventures into a national public domain, had the effect of establishing his reputation as a leading African American social leader.

Finally, Du Bois's organizational work within the National Association for the Advancement of Colored People (NAACP), from 1910 to 1934 (which led to the founding of *Crisis Magazine: A Record of the Darker Races*), is the most substantive place for analyzing his pioneering periodical-based leadership in African American reform matters. While working within the NAACP, he served as the group's co-founder, Director of Publicity and Research, executive board member, and editor and chief writer of the organization's periodical, *Crisis Magazine*. At the core of Du Bois's periodical authorship, within the pages of *Crisis Magazine*,...
was a powerful interplay between the NAACP’s desire to provide the African American community with leadership and Du Bois’s longstanding ideals as a professional scholar providing leadership via periodical authorship. Although social protest against racial discrimination was the chief preoccupation of the NAACP during the period of Du Bois’s periodical authorship, a latent, yet insistent desire to advance the social and moral dimensions of the national African American community existed among its executive board members. This desire partly allowed Du Bois to realize his career-long ambitions to secure institutional support for a utilitarian periodical devoted to reforming African Americans as well as to protesting on behalf of them.

REFERENCE NOTES


5. Darnton 30.


7. It is important to note here that Ashton’s work is not singly devoted to Du Bois’s periodical work at Horizon. Ashton also considers other nineteenth-century African Americans such as Booker T. Washington and Frederick Douglass, whose writings appeared in periodicals as well.


12. Du Bois's brief tenure within Alexander Crummell's *The American Negro Academy*, which will be discussed in chapter 2, was also due to these reasons.


On the Day of Pentecost, the Spirit of the Lord descended from heaven and revealed himself to his Apostles. Prior to this Biblical event, Jesus informed his Apostles that the Spirit of the Lord would come forth again with instructions to spread the coming of the Kingdom of God: "But ye shall receive power, after that the Holy Ghost is come upon you: and ye shall be witnesses unto me both in Jerusalem, and in all Judaea, and in Samaria, and unto the uttermost part of the earth." After they had received their instructions from the Holy Spirit, the Apostles and their followers set forth all over the land to spread the Gospel.

During the mid-17th century, the gospel was still being spread to all corners of the world. The Age of Exploration, fourteen centuries later, provided explorers with access to economic opportunities and with foreign souls to convert to Christianity. The colony of South Carolina, founded in 1670, was subject to Christian missionary activity like all British colonies. The Anglican missionaries sent to the colony of South Carolina were faced with a formidable task. Three main factors characterized their struggle to Christianize slaves in the colony. First, Anglican conversion required the complete re-creation of the slave’s spirit and culture. Second, in order to educate the slave, the Anglican missionary needed a large amount of time, which most masters were unwilling to concede. Third, and probably most importantly, the influence of indigenous African religions and Catholicism prevented the Anglican missionary from being highly successful. This monograph chapter will analyze the trials, tribulations and jubilation experienced by Anglican missionaries in converting Negro slaves from 1670 to 1750.

Slaves brought to colonial South Carolina during the first decade of the 18th

---

1 The Holy Bible, King James Version. Acts 1:8
century arrived with a cultural heritage that has not been properly explored. Historians such as Eugene Genovese, Daniel C. Littlefield, John D. Duncan and John Blassingame have examined slave culture in a vacuum, usually devoid of any clear understanding of indigenous African culture, especially with regard to religion. Each one of these historians would contend that religion was important to Negro slaves, but their analyses fail to uncover the depth of the African-religious heritage. John Thornton is one of the few cultural historians who placed an appropriate emphasis on examining the African religious influence of the past. He is the only scholar, to date, who has really examined the Catholic and other Protestant influences in the lives of Africans slaves transported to the Americas.

It is imperative to understand the cultural baggage that these slaves brought with them, either directly from Africa or from the West Indies. There is no way of really knowing the origin of each slave in South Carolina during the first decade of the 18th century. Some of them made their way to South Carolina via Haiti, Barbados, and other islands in the Atlantic Ocean. Others came directly from West Africa, specifically a geographical range that covers from present day Senegal to Angola. Mechal Sobel has offered a critical analysis of West-African religions during the trans-Atlantic slave-trade period. She determines that indigenous West Africans had a keen spiritual knowledge and religious understanding. Spiritual knowledge seems to transcend every culture in West Africa and there are five basic categories to their spiritual beliefs: (1) God, is the first creator; (2) spirits, of the recent dead and of great predecessors must be respected; (3) man, has more than one spirit, or several aspects of his spirit; (4) animals and plants,

---


3 John Thornton, Africa and Africans: In the Making of the Atlantic World, 1400-1680. (Cambridge, MA: University Press, 1992) Chapter 8 entitled "Transformation of African culture in the Atlantic world examines the role of Catholic missionaries in Africa before and during the years of the Middle Passage.

4 For a larger examination one can examine Philip Curtin's Africa and Africans (New York: Published for the American Museum of Natural History, 1971).

5 Like most American historians of Africa, I unfortunately fall into the trap of calling these inhabitants Africans. One must recognize that Africa is the largest continent on the earth, and this monolithic terms can not adequately characterize all the various people's of this continent. Because of all our lack of understanding of the different ethnic groups on the continent, we use this broad qualification because of a lack of knowledge. For the purpose of this study, we I say African, I am specifically talking about those natives from the Western Coast between Senegal and Angola.
which can also have spirits, but which as well as man, can be inhabited by alien spirits, (5) as can phenomena and objects. Each one of these factors provided Africans with a spiritual anchor; the Sacred Cosmos was the foundation of their lives.

Some West-African slaves were introduced to Christianity before they stepped on the shores of colonial America. West Africans had contact with European Christian countries as early as 1441. Portugal, Spain, and other Europeans nations dispatched Catholic missionaries on trade ships to convert the Africans. Missions in Kongo and Angola can be traced back as far as 1491 when King Nzinga Nkuwu, of Kongo, was baptized into the Catholic Church. In fact, the Kongo rulers instituted Christianity as the official religion and had a state supported church. John Thornton documented the establishment of the first Christian church built in Kongo, which was dedicated to the Virgin Mary. Spiritual elements of West-African religions parallel several spiritual tenants of Christianity. The indigenous West-Africans belief in one supreme being, a need to worship and present sacrifices to that supreme being, and a spiritual communion with a higher power are similar to Christian beliefs. Also, the Catholic Church’s saint worshipping parallels deity and ancestor worship for West Africans: “Running through the African Sacred Cosmos is the constant concern with the past, paralleled by a concern with the present—with the clan and with elders,... but there is no concern for the future.”

This brief analysis of West-African religion suggests that slaves arrived in the New World with a keen spirituality, a spirituality based in a knowledge of a supreme being and an understanding of spirit possession. However, it cannot and does not propose to explain all of the thousands of individual and specific religious practices of West Africans. Several West-African ethnic groups were monotheistic and believed in communion with a supreme being, two key components of Christianity. It appears that at least two West-African countries were

---

7 John Thornton Africa and Africans In the Making of the Atlantic World, 1400-1680. Thornton dedicates an entire chapter of his text to examining the Christian influence in West Africa. It is apparent that many of the slaves that arrived in the New World had either experienced of heard of the Christian religion.
8 Ibid., 17.
Christian states before the trans-Atlantic slave trade commenced. Therefore, it is likely that many of the slaves arriving in the New World had either been converted to or were aware of the Christian religion before they arrived in the New World. Although Margaret Creel argued that: “the period of the Great Awakening can be viewed as seed time for planting Christianity in the Lowcountry,” the seeds of Christianity were planted in many African slaves even before the colony of South Carolina was established.  

**THE SETTLEMENT OF SOUTH CAROLINA**

On March 15, 1670 a group of English proprietors founded the colony of South Carolina in the Port Royal area of present day Charleston. Before Europeans settled in this part of Charleston, the territory was inhabited by Indians and settlers from the West Indies. As Robert M. Weir has argued, the early settlers recruited French Huguenots and English Dissenters to help them populate the new colony. During the early years of the settlement, there was a plethora of different religions and cultures practiced in the colony. Religion played a significant role in the lives of the early settlers, and they incorporated its importance in the second Fundamental Constitutions of Carolina, signed March 1, 1670: “since charity obliges us to wish well to the souls of all man, and religion ought to alter nothing in any man’s civil estate or right, it shall be lawful for slaves as well as others, to enter themselves and be of what church or profession any of them shall think best, and thereof be as fully members as any freeman.” Even though members of the Church of England were a minority population in the colony before 1700, their influence would soon prevail over the entire colony. Tolerance would prevail until the Colonial Council adopted the Church of England as the state-supported religion in 1706. The Church of England formed the Society for the Propagation of the Gospel in Foreign Parts (S.P.G.) in 1701. As the evangelical wing of the church, mission-

---


aries were sent throughout the British colonies. The goal of the society was threefold: First, it was committed to shepherding and maintaining the current membership of Anglicans who were dispersed throughout the British Empire. Secondly, Anglicans wanted to spread the Christian gospel to those persons who they deemed heathen, since Anglicanism was viewed as the true and only form of Christian worship. Anglicanism was both a Protestant denomination and a culture; thus, potential converts were expected to submit themselves to spiritual training and education. Thirdly, the society was formed “to convert the Negro slaves in Christianity and to better their lot under slavery in cooperation with their masters.”

The first Anglican missionary sent to the colony was the Reverend Samuel Thomas, who arrived in Charles Town on Christmas Day, December 25, 1702. From his initial observation, he recognized various groups of Protestant Dissenters, including French Huguenots, Presbyterians, Anabaptists and Baptists in the colony. In some parishes he found no acknowledged members of the Anglican church. In his written request for Bibles and Common Prayer books to give to “the poor Negros,” he noted that there were many Anabaptists and that their preachers were ignorant and inadequate to conduct religious education. Based on his letter, Reverend Thomas set out to instruct the Negroes in the Christian faith; however, his original mission was to convert the native inhabitants (i.e., the Indians) of South Carolina. When he arrived, he also realized there was a larger pool of unsaved sinners who needed to hear the good news of the saving grace of Jesus Christ. This would prove to be a formidable task for the preacher since there were not many White Anglicans in the colony to help him or to promote the Anglican faith.

SPIRITUAL REFORMATION

Reverend Thomas’s main goal was to convert Negro and Indian slaves to Christianity through the Anglican faith. In his initial examination, he noticed that only a marginal number (20 of about 200) of Negro slaves attended church:

12 Frank Klingberg, ed. The Carolina Chronicle of Dr. Francis Le Jau., 5.
13 Ibid., 2.
"Twenty of which I observe to come constantly to church, and these and several others, of them well understand the English tongue and can read." 15 What was even more disturbing was that in 1702, he found only five White-Anglican Communicants. An Anglican Communicant was an individual who was deemed worthy to participate in the Holy Communion. In other Protestant denominations, once one is baptised into the church, one is allowed to participate in communion; however, the Church of England required members to reach a prescribed spiritual level prior to receiving communion. Because of the small number of Whites who regularly attended church and received communion, Reverend Thomas realized the added burden of Anglicanizing the slaves’ masters, as well as of converting the slaves.

Reverend Thomas presented a detailed account of the religious climate in the colony of South Carolina in 1705. This report describes the geographical layout of the colony and the different religious groups that lived within the colony. The presence of dissenting Protestant groups complicated these early efforts to present a pure form of Anglican Christianity. If a slave was owned by a member of the dissenting population, he probably was unable to be converted to the Anglican faith.

The next Parish to Charles Town is Goose Creek, one of the most populous of our County Parishes containing (as near as I can guess) about 120 familys in which Parish live many person of considerable note for figure and Estate in the county, many of which are concerned in the Government as Members of the Council and Assembly, most of these Inhabitants are of the profession of the Church of England, excepting about five familys of French Protestants, who are Calvinists and 3. Of Presbyterians and two Anabaptists. The last parish in Carolina is situated upon a river called Stono..., in the Southern parts of this Parish are settled about 60. Families of Dissenters, Presbyterians and Anabaptists, but the northern part thereof near Charles Town, are about 40. Families who profess themselves of the Church of England, here is no Church nor minister. 16

15 Ibid.
16 SCHGM V. IV., 3-32.
Thomas' report illustrated that the spiritual state of the colony, from an Anglican point of view, was in despair. Between 1670 and his arrival in 1702, no dissenting denomination had organized missionary work for the slaves; yet, protestant dissenters populated most of the parishes, with Anglican worshippers in the minority. The lack of Anglican congregants complicated Thomas's efforts to Christianize the colony. The lack of assistance coupled with the fact that he was not able to communicate with either the native inhabitants or first-generation African slaves made his task extremely difficult.

Language barriers and West African worship practices prevented Reverend Thomas from understanding the indigenous spirituality of the African slaves. These cultural differences required Thomas to create a specific method of teaching Negro slaves. In order to convert the slaves, he had to be able to gain access to their spirituality and be able to communicate with them. During his second year in the colony, he requested that the Society send him prayer books in Spanish: “I am still promised some Indian and Spanish Books of prayer with some translations of the creed and some prayers in the Savannah Tongue.” Spanish and Catholic influences played an important role in the lives of Indian and Negro slaves, and the Catholic influence proved to be a major hindrance in proselytizing the slaves. Anglican doctrine was antithetical and cynical of the Catholic Church. The challenge of converting the slaves was compounded because those slaves who had been brought into the Spanish Catholic Church needed to learn English and rid themselves of all “Romish Influences.”

Not only did communication problems circumvent Thomas’ efforts, but also he was the only Anglican missionary in the colony until 1706. In 1704 he reported that South Carolina had but two ministers in the entire province. In order for the Anglican mission to be successful in converting and educating large numbers of slaves, Thomas writes: “The Country stands in great need of more ministers especially of one for a Place called Goose Creek, a Creek the best settled

17 Frank Klingberg, ed. The Carolina Chronicle of Dr. Francis Le Jan, 49.
18 Ibid., 102. Le Jan referred to those persons who practiced the Catholic faith as being Papists or Romish. Every time he referred to a Catholic, he did so in a derogatory and degrading way. For instance in a letter written to the Secretary of the Society On February 18, 1711 he writes: “there are two poor [Negro] Slaves born & brought up among the Portuguese that are very desirous to Abjure the popish heresy's and be Read to the communion among us.”
with Church of England families in Carolina, they have a small Church built, and at the earnest request of some of the Inhabitants I lately preached there....”

The first few years of their missionary presence in the colony were difficult and unsuccessful; however, the efforts to convert the White settlers proved beneficial. In 1706, under the administration of Governor Nathaniel Johnson, the South Carolina Colonial Council adopted the Church of England as the official religion of the colony.

Reverend Thomas’s prayers were answered when Reverend Dr. Francis Le Jau was sent to the colony on October 18, 1706. Le Jau remained in the St. James Parish, Goose Creek, South Carolina until his death on September 10, 1717. Reverend Le Jau sent numerous letters to the Secretary of the Society, which contain important information about his slave-conversion efforts in the colony. Le Jau’s descriptions and accounts of several other Anglican missionaries can provide some insight into the religious experience of slaves in South Carolina. Reverend Le Jau lived in Goose Creek, where Reverend Thomas reported that most of the members of the council resided. This environment should have provided him with a cooperative environment for the Christianization of the slaves; however, this was not the case.

At the time of his arrival, there were only 24 communicants in his parish. On April 15, 1707, after being in the colony for only seven months, Le Jau desired to “…appoint some convenient time in the week for instructing the poor and ignorant from among the white, black & Indians,” He lamented that although there were many “teachers and Expounders of all sorts and persuasions,” he found few who understood the essential elements of Christianity. Le Jau never found the support that he needed in order to provide the slaves with a formal conversion experience. In his opinion, the Negro’s behavior and culture demanded a total makeover. He desired to promote a strict program of acculturation. He informed Philip Stubs, a member of the S.P.G. Council: “The Negro are generally very bad men, chiefly those that are scholars. I will baptise none but such as lead a Christian life and of whom I have a good testimony.”

Unfortunately, the masters did not give him the leverage and freedom to imple-

---

19 SCHGM V. IV, 283.
20 Klingberg, The Carolina Chronicle of Dr. Francis Le Jau, 22.
21 Ibid., 24.
ment his program. The feared consequences of an educated slave population circumvented Le Jau’s efforts to educate the Negro slaves.

Le Jau defined a “Negro Scholar,” as a slave who could read and interpret the Bible. Le Jau, like Reverend Thomas, found a small number of slaves who regularly attended church. Those slaves who wanted to be baptized into the church had to be given permission by their masters. Le Jau required that their masters provide him with an account of their virtuous life as a prerequisite to becoming a candidate for baptism. It was imperative, for the Church and for the planters, that they be able to present the Gospel in a way that best suited their own needs. Those slaves who could interpret the Bible for themselves presented a direct threat to the church and to the planters. It was the missionaries’ job to dismantle the slave’s prior spiritual commitments and to establish the Anglican form of worship as their sole religious paradigm.

Slave masters had full control of the indoctrination and acculturation of his or her slave. According to Le Jau, slave conversion was contingent upon the will of the earthly master and not the ecclesiastical one. The Negro slaves were forced to take a circuitous route to salvation that was not required of other converts. Furthermore, Le Jau made sure that each slave understood that by being baptized into the Church of England they were freed from their sins but not from the bondage of slavery. It seems clear that these mental shackles had to be enforced so as to keep the slaves in their proper place in society. Le Jau required each Negro candidate for baptism to agree to the following oath: “You declare in the Presence of God and before the Congregation that you do not ask for holy baptism out of any design to free yourself from the Duty and Obedience you owe to your Master while you live, but merely for the good of your Soul and to partake of the Grace and Blessings promised to Members of the Church of Jesus Christ.”

The slaves’ spiritual growth was transmitted and directed through sanctioned activities of the Anglican Church and their masters. For if slaves could read and interpret the Bible, as Le Jau claimed, there was the fear that they might have recognized a different Savior from the one portrayed by the Anglicans. Their Jesus

22 Ibid., 69.
23 Ibid., 76.
24 Klingberg, The Carolina Chronicle of Dr. Francis Le Jau, 60.
could be one who came to give sight to the blind, clothes to the naked, and to free
the enslaved, regardless of color, ethnicity, or national origin.

The consequences of educating the slave population strained and, at some
points, severed the missionary to slave-master relationship. In order to recon­
struct the slaves’ mentality and their understanding of religion, the Anglican mis­
missionary had to make sure that no outside interference prevailed. Most importantly,
they did not want slaves trying to interpret the Bible and forming a contradictory
understanding of Christianity. On one specific occasion, a slave questioned his
master about what he had read in the Bible. What the slave read was different
from what the missionaries and the master taught him about being a good
Christian slave. The master approached Le Jau because he was concerned that
other slaves would not only begin to question parts of the Bible that related to
their servitude but also the slave system itself. Le Jau asked the S.P.G. council
whether he should continue the practice of teaching slaves to read, saying: “…I
fear the Consequences… I humbly submit to the Judgment of my Superiors in all
Cases.”

Le Jau feared these educated slaves would question the oppressive sys­
tem in which they lived, which would agitate their masters. Consequently, the mas­
ters would prevent Le Jau from educating the slaves and interrupt his conversion
efforts.

Le Jau sent a report to the S.P.G. council every six months chronicling his
conversion efforts. Each letter reported the “Spiritual State of the Parish.”
Apparently, these reports were supposed to demonstrate how successful the mis­
missionaries were in converting the slaves; however, these letters do not really
account for the spiritual state of the parish. They simply present a quantitative
analysis of the Anglican church membership. For instance, in July he reported:
“The spiritual state of my Parish till June the 13th 1710. Was thus; baptised 19
among whom 3 Negroe Men. Communicants about 50 in all;… but no less than
30 constant Communicants every two Months among whom 4 Negroes: 3 mar­
riages and one Child Buyred.”

In four years, then, he had only baptized four
male Negro slaves. His report suggests that there had to have been some factors

25 Ibid., 74.
26 Ibid., 81.
preventing him from reaching greater success. One reason why Le Jau was not very successful in baptizing a large number of Negro slaves was because Anglican conversion was contingent upon the slave learning how to read the catechism and internalizing its spiritual elements into their lives. Reportedly, if the slave did not live up to the spiritual standards that Le Jau and the church set, he or she was not worthy to be called an Anglican. Furthermore, just because a person was baptized, he/she was not fully a member of the church. According to Anglican doctrine, in order for converts to participate in the Eucharist they had to be communicants, according to the local minister. In five years, Le Jau allowed only five Negro slaves to participate in the Eucharist.

Standing alone, Le Jau's vestry records are not good nor accurate indicators of the spiritual state of the entire colony. His reports and his membership quotas neither represent the entire Christian population of the colony nor the number of persons who professed a belief in Jesus Christ. However, his records do provide church membership figures for the Church of England and demographic figures as well. These reports suggest Le Jau moved at a snail's pace to bring slaves into the church. Whether this was by design or because of friction with the slaves' masters, we do not really know. Because Le Jau demanded that each slave be trained in the faith, and not just baptized, his numbers indicate only minimal success. In his population estimates for his first full year in the colony, he reported there were 450 Negro slaves of which many had been baptised; no actual figure is given. In 1709, he estimated that his congregation was about 100 persons and he added two more baptized Negro male slaves. Between January and June of 1710, he baptized 19 persons of whom three were Negro men and had added six more communicants, four of whom were Negro. Le Jau did not report that any slaves were baptized or made communicants in 1711. It would not be until January of 1714/15 that Le Jau would report adding any Negro communicants. In 1714, the number of Negro communicants in Goose Creek remained five, although Le Jau had baptised over 25 slaves. Out of the 90 families living in Goose Creek, which Le Jau estimated to be about a thousand individuals, there were only 35 communicants. Between July of 1714 and January of 1714/15 he added three
Negro communicants. It appears, however, that Le Jau succeeded in allowing the masters to let him baptize large numbers of children in the parish. His records, however, do not differentiate which children were White or slave. He lumps all children baptized into one category. Most likely, most were the children of slaves because the children were not yet tools of labor. Their absence from the fields for religious instruction would not affect profit, so masters were more willing to allow him access to slave children for religious education.

Le Jau died on September 10, 1717, and in his last spiritual report to the Society, he reported that there were a total of 60 communicants in his Parish. Between the years 1706 and 1717 he was able to bring in 25 communicants, eight of whom were Negro slaves. There is no way to know how many slaves he actually baptized because he failed to provide a numerical estimation in every letter; however, no report ever showed that he baptized more than five slaves in a six-month period. The unwillingness of many of the masters to allow Le Jau time to catechize the slaves, and the unwillingness of the slaves to subject themselves to the wishes of the Anglican Church prevented Le Jau from converting a larger number of slaves. In several of his letters, one can sense his frustration with the masters and the slaves for not understanding the importance of converting to the Anglican Church. Le Jau commented: “Our baptised Negroes with several others that came to be Instructed in the Principles of our holy Religion have behaved themselves very well upon all occasions... They prayed and read some part of their bibles in the field and in their quarters in the hearing of those who could read and took no notice of some profane men who laugh at their devotions.”

For those slaves who were already Christian before he arrived, his ministry allowed them to continue developing their spirituality and to partake in the Christian worship experience.

The Yemassee’s war and Le Jau’s death had a direct impact on the spiritual training and subsequent conversion of slaves between 1716 and 1725. John Wesley Brinsfield reported: “The Anglican (S.P.G.) missionaries at Goose Creek, St. Andrews, and St. John’s, Berkely, were all killed and their mission closed most of the churches.” Thus, between 1717 and 1722 church membership declined.

27 Ibid., 198.
Brinsfield's argument is supported by Le Jau's memoirs and recollections of the war. Before Le Jau died, he reported that because of the war, many of his families fled the area, and several members of his congregation were left dead. Political problems during the second decade of the 18th century also prevented the citizens of South Carolina from being too concerned with slave conversion. On August 11, 1720, South Carolina became a Royal Colony. Unhappy settlers argued that the proprietors failed to provide a medium for the spiritual growth of the Anglican faith and tolerance for other faiths: "In the petition of the Council and Assembly to the King, February 3, 1719/20, the Proprietors... were denounced for failing to build Anglican churches and for their gross violation of the rights of the Dissenters in their manner of securing the law for establishing the church." 29

In response to the claims of the settlers, regarding the lack of support by the proprietors, the S.P.G. opened the Charleston Negro School in 1743. The school, under the administration of Commissary Alexander Garden, was developed to promote the religious and intellectual development of slave children. Even though the Slave Code of 1740 prevented the education of slaves, masters were seemingly willing to ignore the consequences of educating slave children. The intention of the slave code was to place more restrictions on Negro slaves in order to prevent any future rebellions. Coupled with the need for safety was the desire to continue the economic success of the colony. Some masters feared slave education and conversion activities would hinder economic growth.

"Meanwhile the wealth of the province was rapidly increasing, and, as the value of their slaves increased, the planters showed a tendency towards becoming more unwilling to release them for instruction both because of the time thus consumed and because of the current belief, enacted into law by the Slave Code of 1740, that encouragement in the field of education was a contributing factor to the slave insurrection which occasionally broke out." 30

30 Klingberg, Appraisal of the Negro, 74.
The school closed after several local masters removed their slaves, and there was a lack of support from the community. Additionally, the school had problems finding volunteers to serve as teachers. The S.P.G.'s experiment in Charleston was further hampered when the Church of England began removing ministers from the colony beginning in 1750. By 1763, there were only five S.P.G. missionaries in the colony of South Carolina.

TEMPORAL DEMANDS OF SLAVE CONVERSION

The ownership of time was an essential component in the relationships among slaves, masters, and missionaries. Mark Smith's *Mastered By the Clock* analyzes the temporal relationship between the master and his slave. Even though his study is centered in 19th century antebellum slavery, his argument holds true for the colonial period as well. Despite claims by other notable historians, Smith argues that slave masters, like industrial factory owners, had a keen temporal consciousness and resisted any encroachment on their control of time: "They were determined to regulate the labor and behavior of slaves by the clock... because slave’s time was, by definition, master’s time." Missionaries needed the master’s time and the slave’s time in order to propagate the gospel; but it appears that neither was willing to yield. As Le Jau’s mission continued, he increased his efforts to bring more slaves into the church; thus, he began to impose on the temporal control of the masters. He acknowledges: “Their masters seem very much averse to my Design, some of them will not give them Leave to come to Church to learn to Pray to God & to serve him, I cannot find any reason for this New Opposition but the Old pretext that Baptism makes the Slaves proud and undutiful; I endeavor to convince them of the contrary from the example of those I have baptised, and chiefly those who are admitted to our holy communion who behave themselves very well.”

Anglican missionaries required that a slave be able to read and recite the Lord’s Prayer, the Apostle’s Creed, the 23rd Psalm, and other Christian literature before they could be baptized. Reverend Thomas seems to have been very suc-

---

cessful because, on March 10, 1703/4, he boasted: “By my encouragement about
20. Negroes have learned to read, and I am acquainting them as I have opportu-
nity with the Principles of the Christian religion, and have lately baptized one
Negro man, and hope in some time to find more fitted for that Holy Institution.”
In one year Thomas was able to teach 20 slaves to read, which appears to be a
remarkable feat. One might argue that either Thomas is exaggerating his success
or that these slaves already had some knowledge of Christianity and the English
language. Seemingly, it would have taken a lot more time than he declares to
Teach the slaves to read. His reports surely do not coincide with the reports Le Jau
wrote from the same territory years later. If Thomas’s report is true, one might
surmise that in the early period of the settlement, masters were more willing to
allow their slaves time off for learning.

When Le Jau first arrived, he reported that as soon as his house was built he
was going to take a full day for the instruction of the slaves. He seemed not to take
into account that as tools of production the slaves were required to be on task
every day, except most Sundays. Le Jau seemed to think that slaves would benefit
from expressing an interest in becoming a Christian, since their masters would
allow them time off for religious training: “I have presumed to give an account of
1000. slaves belonging to our English in Carolina, many of which are... desirous
of Christian knowledge and seem to be willing to prepare themselves for it in
learning to read for which they redeem time from their labour.” He reports that
many already could read the Bible and that many were learning to read by the
time he left the area. Even though there are some exceptions, it seems that
most masters were not willing to allow slaves any time away from their regular
work routine for religious training. As to his point that slaves were able to
“redeem time from their labour,” this must have been only characteristic of the
early period in the colony. Le Jau was not the only Anglican missionary who felt
tension from the masters. Reverend Robert Maule, the missionary assigned to the
St. John’s Parish, reported in 1710 that most masters were unwilling to allow their
slaves to be baptised because: “of a mistaken notion that they are free after they

33 Ibid., 280.
34 Ibid., 37.
are baptised." 35 These masters feared that Christian doctrines of salvation and freedom were likely to corrupt the minds of their slaves. Apparently, they thought that it would be fine for the slave to spend eternity in ecclesiastical freedom, but while they were on earth, masters were certain that they were bound to their earthly masters.

In addition, Le Jau recognized that on Sundays the slaves used their only free day in idleness: "It has been Customary among them to have their feasts, dances and merry Meetings upon the Lord’s day...; I tell them that present themselves to be admitted to Baptism, they must promise they’ll spend no more the Lord’s day in idleness, and if they do I’ll cut them off from the Communion." 36 In another account he also reports: "The Lord’s day is no more profaned by their dancings at least about me." 37 In Western culture, Sunday typically is reserved for religious worship and rest; however, for slaves, this was the only day of semi-autonomy. What free persons could do Sunday through Saturday, slaves had to squeeze into one day. Sunday became the only day on which slaves could practice their indigenous religions, have their own private worship experiences, and celebrate their Africanism. As Robert Weir suggests: "Sunday was a day off everywhere; sometimes part of Saturday was too. In South Carolina, moreover, the task system permitted additional free time during the week." 38 However, this free time could be viewed as work time if slaves were made to go to church or Bible-study classes.

Based on the number of Negro communicants reported, it is apparent that not too many slaves were willing to give up their Sundays for the necessary Christian education that Anglicanism conversion required of them. Furthermore, most masters were not willing to interfere with their slaves’ free day because they wanted to give the slaves at least one day to rest. But according to one missionary report, on some plantations the slaves were made to work even on Sundays. The missionaries, however, wanted the slaves to participate in religious instruction on Sundays: "Permit to my zeal My Lord to Implore your favour and Charity in behalf of the poor Slaves that live amongst us; they are suffered, some forced - to work

35 Robert Maule to John Chamberlayne, (June 3, 1710) S.P.G. MSS, A 5, No 133, 300.
36 Ibid., 60.
37 Ibid., 77.
38 Weir, Colonial South Carolina, 188.
upon Sundays, having no other means to subsist, they are used very cruelly many of them, the Generality of the Masters oppose that they should know anything Christianity."39 Noted antebellum historian, Eugene Genovese, argued that during the antebellum period, the slave’s and master’s paternalistic relationship required a mutual temporal agreement. The masters allowed them to have Sunday off, and the slaves reciprocated by working Monday through Saturday. Evidence of this paternalistic relationship can be seen in colonial South Carolina as well.

These temporal concerns not only affected the amount of time allowed for conversion activities but also for the impending coming of the Lord. Le Jau seemed to believe that he was racing against the ecclesiastical clock to bring the slaves to Christianity. In other words, he did not want the Lord to return when his mission had not been successful. This concern was complicated by the fact that the slaves themselves were not willing to submit to Christianity, based on the marginal number of slaves who converted. Le Jau even wrote the S.P.G. council to know if the Anglican missionaries and masters would have to provide an account at the judgment for the sins committed against the slaves. After witnessing a slave being beaten to death and one committing suicide because of the mistreatment by her overseer, he wrote: “and what is most amazing, I cannot make them comprehend that their neglect is an habitual sin.”40 Physical beatings and spiritual neglect concerned Anglican missionaries like Le Jau and Gilbert Jones in Christ Church Parish. Jones remarked that the masters were only concerned by the wealth that the slaves brought and not their spiritual development.41 The masters’ desire to get the maximum amount of labor out of their slaves minimized the time a slave was allowed for religious training. However, at least one Anglican missionary, the Reverend Ebenezer Taylor, was very successful in his conversion efforts.

The Reverend Ebenezer Taylor baptized the most Negro slaves in the colony of South Carolina. He was assigned to St. Andrews Parish and baptized over fourteen slaves at one time on Alexander Skene’s plantation. The efforts of Taylor and

40 Ibid., 130.
41 As cited in John D. Duncan, Servitude and Slavery in Colonial South Carolina 1670-1776. (Ann Arbor, MI: University Microfilms International, 1972), 308.
Mr. Skene's sister, Mrs. Hague, led many slaves to be brought into the Christian fold. She believed that it was her spiritual duty to Christianize the slaves on her brother's plantation. Because Alexander Skene was an absentee planter, he was not subject to being influenced by nearby planters to refrain from Christianizing his slaves; yet, his sister was subjected to ridicule from surrounding planters. She was never able to convince them that it was imperative that they convert their slaves to Christianity. By 1716, Reverend Taylor had baptised 50 slaves on the Skene's plantation. Taylor's success seems to be an exceptional case and does not characterize conversion success in most parishes.\(^{42}\)

As the slave population increased in South Carolina, so did the need for more time to instruct the Negroes. The figures in Table 1 are based on 1724 tax information.

<table>
<thead>
<tr>
<th>Parish</th>
<th>Number of Slaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Philips and Charles Town Neck</td>
<td>1,113</td>
</tr>
<tr>
<td>Christ Church Parish</td>
<td>557</td>
</tr>
<tr>
<td>St. Thomas and St. Dennis</td>
<td>775</td>
</tr>
<tr>
<td>St. John and English Santee</td>
<td>1,271</td>
</tr>
<tr>
<td>St. James Goose Creek</td>
<td>1,650</td>
</tr>
<tr>
<td>St. Andrews</td>
<td>1,834</td>
</tr>
<tr>
<td>St. George</td>
<td>469</td>
</tr>
<tr>
<td>St. Paul</td>
<td>1,245</td>
</tr>
<tr>
<td>St. Bartholomew</td>
<td>151</td>
</tr>
<tr>
<td>St. Helena</td>
<td>51</td>
</tr>
</tbody>
</table>

Between 1720 and 1730, 8,810 Negro slaves arrived in Charles Town, South Carolina.\(^{43}\) Between 1706 and 1723, 32,233 Africans arrived in South Carolina.\(^{44}\)

\(^{42}\) Klingberg, *The Carolina Chronicle of Dr. Francis Le Jau*, 76.

\(^{43}\) This figure is based on a chart found in John Duncan's dissertation. He found the figures in "An Account of the Number of Ships and Vessels entered and of Negroes imported from the Year 1706 to 1739, both included at Charles Town, S. Carolina" *The Gentleman's Magazine*, XXV (1755).

South Carolina’s economic success in agriculture, especially in rice and indigo production, facilitated the need to bring in more slaves to cultivate the land. Coupled with this economic success was a lack of desire of masters to give their slaves time off for Christian education. By 1730, over 20,000 Negro slaves resided in South Carolina. There were too many Negro slaves living in South Carolina for the small number of Anglican missionaries to be highly successful. Furthermore, the limited number of missionaries in the colony could not get the masters to concede any time for the slaves’ Christian education: “The inhabitants and their slaves are so busy a planting that I can get no body to work in the Lord as yet, but as soon as the Scout men are settled, I shall put them to it.”

In 1723, the Reverend Francis Varnod was sent to St. George Parish in Dorchester County. The parish had been destroyed and deserted after the Yemassee’s war. By 1728, he recorded that the parish was inhabited by over 1,300 slaves, which included 108 Christians. Varnod’s records mimic Le Jau’s, in that he baptized no more than two to four slaves at any given time. Reverend Taylor’s account seems to be the largest mass baptism before the Great Awakening in the colony. Unlike, Le Jau and Varnod, it does not appear that Taylor was too concerned about a long Christian education process before conversion. It is safe also to assume that not only was conversion contingent upon the will of the master but also of the missionary as well. Taylor seemed to have shortened the required long education process for conversion or did not require it at all. Because of the large amount of slaves on Skene’s plantation, Taylor might not have been able to establish a uniform Christian-education program. Even though he and Mrs. Hague were committed to Christianizing the slaves, they realized that their labor in the fields came first. Economic success and potential dictated the terms in which masters would allow their slaves time off for conversion activities. Commissary Alexander Garden, who was in charge of all missionary activity in the colony, remarked in 1724 that in some parishes, “no means are used for their conversion.” Clearly, economic temporal concerns hindered the missionaries’ efforts to convert the slaves to Christianity.

CATHOLIC AND SPANISH DETERRENTS TO CONVERSION

Le Jau reported to the Secretary of the S.P.G.: "I have in the parish a few Negro Slaves and were born and baptised among the Portuguese, but speak very good English, they came to Church and are well instructed so as to express a great desire to receive the H. Communion amongst us, I proposed to them to declare openly their Abjuring the Errors of the Romish Church without Declaration I cou'd not receive them...." Clearly, missionary activity on the continent of African and within the West Indies provided the colony with a small proportion of Catholic slaves. John Thornton argued that the Catholic Church had a tremendous impact upon certain sections of West Africa that had been visited by Catholic missionaries. The presence of Catholic slaves provided another problem for Le Jau and for the entire colony because of the close proximity of Spanish Indians and the Spanish territory. South Carolinian settlers likened Spanish agitation with Catholicism. They also feared that the Spanish would be able to use Catholicism as a means to attract slaves and Indians to their settlement in nearby St. Augustine.

Again in 1710, Le Jau reported: "There are 3. Or 4. Portuguese Slaves in this parish very desirous to receive the Communion amongst us; I framed a short Modell of Submission grounded upon some Popish Tenents which they told me of their own Accord...; I require of them their renouncing of those particular points, the Chief of which is praying to the Saints and that they must not return to the Popish Worship..." This account is consistent with Stobel's argument that the African and Anglican religious practices were like opposite ends of a continuum. "The Roman Catholic and African world views and Sacred Cosmos are closer in nature..." As stated earlier, it was imperative that the Anglican missionary be able to transform the religious practices and beliefs of the slave within an Anglican construct. Le Jau demanded that each one of these slaves publicly denounce the Catholic Church and vow to unite with the Anglican Church. Le Jau traced the spiritual development of the two Catholic slaves who wanted to be made communi-

---

47 Ibid., 76.
49 Ibid., 77.
cants of the Anglican Church. He stated that he spent two years training and keeping a watchful eye on them. The fact that these two slaves were born to Catholic parents proves that they were not first generation Catholics and had family history in the Catholic Church. Their parents would have had to accept Catholicism before they arrived in South Carolina since there was no solid evidence of a Catholic presence in the colony until the late 18th century.

Once the slave population of South Carolina had reached the majority, White citizens began to fear their safety. From 1670 through 1714, the slave population of South Carolina was steadily increasing. In 1670, by some estimates, there were 200 Whites and 30 Negro slaves in the entire colony; yet, by 1720, there were 17,048 Whites and 12,000 slaves in the province. Evidence used by Robert Weir suggests that by 1708 half of the South Carolina population was Black, and by 1720 two-thirds of the colony was inhabited by Negro slaves. Whatever the true population figures, it is obvious that Negro slaves composed a majority of the population. Constant small attacks by the Indians and fear of the Spanish settlers in nearby present-day Florida kept the colonialists in a constant state of fear. This fear appears to have been exacerbated by the presence of the Spanish and Indian Catholics in nearby Florida. David D. Wallace reports that in 1711, a Spanish Negro named Sebastian started an insurrection in the colony. Wallace does not say whether Sebastian was Catholic or not, but the fact that he was a Spanish slave suggests he was Catholic. Le Jau reports in 1714 that there was a rumor of a planned conspiracy that was supposed to take place in Goose Creek, where a good number of slaves lived. The constant threat and possibility of a large slave insurrection demanded masters have a strong hold on their slave population. Systemic control of the Negro slave population, as well as a fear of the nearby Catholic presence, further complicated the efforts of the Anglican missionaries.

Le Jau indicates that many of the settlers in the colony believed the Indians had conspired with the Negroes to attack the settlement in 1714. The constant threat of the Indians living in the colony worried the settlers, especially if the

51 Ibid., 102.
54 Ibid., 70.
Negroes and the Indians were to unite. Their fears came to term when the Yemassee Indians attacked the settlement in 1715. Most of the White settlers in the colony believed the Catholic Spaniards in present-day Florida enticed the Indians to attack the South Carolina settlement and encouraged Negro slaves to run away to the Spanish settlement, "...and offered freedom to all who could escape to St. Augustine." Le Jau believed that the war's causation was due to sins and transgression. He argued God had let his judgment fall upon the colony for not following his will and because of their treatment of the slaves. Specifically, he saw the colonists' treatment of slaves as a "...Scandalous & Presumptuous Transgression of Divine Ecclesiastical & humane laws."

Problems with Indian slaves in previous years demanded a re-evaluation of the colony's protection and security measures. Even though the war was over, the council was still concerned about the presence of Indians within the settlement and also the growing number of slaves within the region. They realized that the slaves and the Indians outnumbered the white inhabitants: "Sometimes led by two or three Spaniard, the Yemassee and armed Negroes would murder planters, sometimes kill and sometimes capture the women, burn the buildings and be off with stolen valuables and slaves before pursuit could be organized." The White citizens of the colony approached the year 1730 with a need to feel secure. Despite the continued pressure to protect its citizens from the Indians and the possibility of an attack by the nearby Spanish settlement, events in the 1730s could not be prevented. In 1737, the Lieutenant Governor of South Carolina wrote to the Duke of Newcastle: "As our negroes are very numerous and more dreadful to our safety than any Spanish invaders, there is an act of Assembly now preparing to have strong patrols established in all convenient districts." In this very same year the South Carolina Gazette reported an uprising in nearby Antigua. These warnings and rumored slave insurrections culminated in one of the most noted slave rebellions in South Carolina, The Stono Rebellion.

57 Easterby, Colonial Records of South Carolina 1739-1741, 303.
58 Cited in David Wallace's The History of South Carolina, 368.
59 South Carolina Gazette (Charleston) Saturday July 23, to Saturday July 30, 1737.
The Stono Rebellion occurred in St. Paul’s Parish, on Sunday, September 9, 1739. A group of about twenty Negro slaves, who had recently come to South Carolina from either Kongo or Angola, massacred over 25 White citizens in the surrounding area. The fact that this rebellion occurred on a Sunday morning, in itself, has significant religious connotations. However, there is strong reason to believe that the slaves who instigated this insurrection were Catholic, and this specific rebellion happened on a Catholic holiday. John Thornton argued: “these same ‘black Christians of the Congo’ were the leading rebels of the Stono Rebellion, susceptible to Spanish and Catholic propaganda.” There is evidence that this attack was carried out by a group of Angolan slaves on what they considered to be a Catholic day of celebration. Whether, they were from the Kongo region or Angola is probably insignificant. The mere fact that this event happened during the weekend of a Catholic celebration suggests that this rebellion, more than likely, had Catholic religious implications.

Following on the heels of the Stono Rebellion was the first Great Awakening, an evangelical movement that occurred in colonial America beginning around 1738. The Reverend George Whitefield was the leader of this evangelical movement, and he made several trips to South Carolina. After a trip to South Carolina and southern colonies, he offered this scathing commentary: “I must inform you, in the Meekness and Gentleness of Christ, that I think God has a Quarrel with you for your abuse of and cruelty to the poor Negroes.” He also believed the recent problems in South Carolina were a direct result of God’s unhappiness with the way masters treated their slaves: “... he has been in a remarkable manner contending with the people of South Carolina. Their houses have been depopulated with the small pox and fever, and their own slaves have rose up in arms against them. Their judgment are undoubtedly sent abroad, not only that the Inhabitants of that,

---

60 It depends upon what historian you read as to where the slaves actually came from in Africa. Peter Wood, et.al. contend that the Slaves came from Angola, but John Thornton contends in his article “African Dimension of the Stono Rebellion” American Historical Review that these slaves actually came from the Kongo region of Africa. Kongo became a Christian nation in the mid-sixteenth century.

61 John Thornton “African Dimensions of the Stono Rebellion” American Historical Review. (October 1991), 1106. This theory is going to be further explored by Mark Smith in an upcoming article.

but of other Provinces, should learn righteousness. 63 It seems clear that this prophecy did not set well with the clergy of the Anglican Church nor with many of its citizens. Whitefield’s words were not only an indictment of the spiritual state of the colony but also of the minimal success their missionaries had in converting their slaves. In light of Eugene Genovese’ contention that: “southerners viewed Christianity as the moral foundation of their social system,” Whitefield’s controversial statements and his denunciation of the South Carolina clergy caused Commissary Garden to ban him from preaching in Anglican churches. 64 His views also merited a heated political and religious debate in the South Carolina Gazette. Several editorials were printed either in defense or in opposition to Reverend Whitefield’s view. One letter commented: “Several of my flock... have been with me, manifesting the great convictions that were stirred up in them by Mr. Whitefield’s preaching;... the good effects of his preaching.” 65 But others presented scathing commentaries on Whitefield’s views and rejected his preaching within the colony.

One of Whitefield’s greatest supporters was Hugh Bryan of St. Helena. He wrote a letter to the editor of the South Carolina Gazette in support of Reverend Whitefield’s desire to promote the Christianization of the Negro. Based on Whitefield’s earlier warnings, Bryan argued that because of the slave masters’ unwillingness to Christianize slaves, recent events represented God’s unhappiness with the citizens of South Carolina. Furthermore, he predicted even more terrible manifestations of God’s wrath. What is significant about this public admission of guilt was that Bryan, himself, was a planter. The planter class did not need dissension within its rank or any other planters affirming Whitefield’s warnings. Not only did he admonish the slave class for their unwillingness to obey God, but also Bryan set out on a one-man crusade to Christianize the slaves in the colony. He wrote a letter to his sister revealing his spiritual awakening and why he believed God had commanded him to take the Gospel to the slaves. 66 Following what he

63 Ibid.
65 South Carolina Gazette, November 1, 1740.
66 Hugh Bryan and Mary Hutson. Living Christianity (London: J. Buckland, 1760), 64.
believed to be God’s commandments, he promoted large revivals with hundreds of slaves, which were illegal events under the provisions set in the Slave Code of 1740. Once the colonial council became aware of these events, they investigated Bryan.\(^\text{67}\) Bryan was indicted but nothing ever came of the case. At one point he deserted the colony for fear of being arrested but later returned to lead more revivals.\(^\text{68}\)

Albert J. Raboteau, in his important study of slave religion in the antebellum South, claimed: “From the very beginning of the Atlantic slave trade, conversion of the slaves to Christianity was viewed by the emerging nations of Western Christendom as a justification for enslavement of Africans.”\(^\text{69}\) This interpretation has been accepted and spread by many historians. Because the seeds of Christianity had already been planted in many indigenous West African cultures, the Anglican missionaries could not ignore the historical spirituality of the slave population. Resistance from the master class and a constant fear of Catholic nations further prevented Anglican missionaries from attaining their goals.

**CONCLUSION**

Klingberg concluded in his appraisal of Negro slaves residing in South Carolina: “The broad fact is that the Negro of the United States became a Christian and so regards himself today. After three quarters of a century of intense activity by the S.P.G. in South Carolina the parishes of the colony were firmly established with home rule, and the inhabitants took over their religious management, including work with the Negroes.”\(^\text{70}\) Klingberg is guilty of reading history backwards. The colonial evidence from South Carolina does not support the argument that Christianity bloomed in the spirits of all South Carolina slaves. What we find in South Carolina is the continuation of a Christian mission that began in the mid-fifteenth century. Very few Negro slaves decided to embrace the Anglican form of Christianity in the colonial period. The Negro slaves of South Carolina arrived in

\(^{67}\) Easterby, *Colonial Records of South Carolina*, 380.

\(^{68}\) see Harvey Jackson’s “Hugh Bryan and the Evangelical Movement in Colonial South Carolina” *William and Mary Quarterly*, 3rd Ser., Vol. 43, No. 4.


\(^{70}\) Klingberg, *Appraisal of the Negro*, 133.
the colony with a keen spirit, one that was responsive and connected to nature and a higher power. Whether they allowed the Anglican missionaries to help develop that spirit toward Christianity was contingent upon their will. Even though the earthly master could force them to sit in a church pew and listen to a sermon, only the slave himself could internalize that message to nourish his soul. We are reminded of the Negro scholar who questioned the master's exegesis of the scripture. He realized that only through a heavenly master could his spirit be fed and redeemed. That Negro Scholar might have remembered a conversation Jesus had with the Jewish believers: “And ye shall know the truth, and the truth shall make you free. They answered him, We be Abraham’s seed, and were never in bondage to any man: how sayest thou, Ye shall be made free? Jesus answered them, Verily, verily, I say unto you, Whosoever committeth sin is the servant of sin. And the servant abideth not in the house for ever: but the Son abideth ever. If the Son therefore shall make you free, ye shall be free indeed.”

71 The Holy Bible John 8:32-836
PART 2: MOORE SCHOOL
OF BUSINESS
The emergence of e-commerce is creating fundamental changes to the way that business is conducted. These changes are altering the way in which every enterprise acquires wealth and creates shareholder value. The myriad of powerful computing and communications technology enabling e-commerce allows organizations to streamline their business processes, enhance customer service, and offer digital products and services. This shift in underlying marketing fundamentals is now the driving force that is luring many organizations to embrace e-commerce. However, as they are learning, organizations must proceed with caution, as the road to e-commerce is littered with failed initiatives. A plunge in the share prices of dot-com companies sent the tech-heavy NASDAQ index almost into free fall down over 70% of the record high of 10 March 2000. Though an economic slowdown was on the horizon, one thing was painfully clear; most Internet “pure plays” could not find sustainable profitability by operating only as e-commerce organizations simply by excelling in the management of technology, information, and consumer behavior. Similarly, established companies that viewed e-commerce as a stand-alone appendage to their business would be less likely to succeed in these efforts. Therefore, it is our contention that firms must clearly recognize their e-commerce initiatives as an integral part of their strategic objectives. In addition, we propose that firms that carefully evaluate their customer and competitor base, as a part of strategic thinking, will reap more benefits than those firms who do not.

Specifically, the study investigated the extent to which large successful companies adopted an e-commerce posture that was integrated with their corporate strategy. Thus, we examined the qualitative portion of the company's Annual Report, the CEO's Letter to the Shareholder, using content analysis. This letter
presents a unique observation deck for the researcher interested in examining corporate strategy and holds potential for determining the innovative methods of the top manager’s strategy (Ginsberg, 1988). Bettman and Weitz (1983) argue that the CEO’s letter, which is a standardized component of the report, provides comparable and more objective data on an organization than would interviews. Pfeffer (1990), recognizing the utility of the CEO’s letter as a source of “objective” data on organizations, has called for increased research use of annual-report data. This study uses the CEO’s letter as input to address the following questions:

1. Is the importance of e-commerce to corporate strategy reflected in improved corporate performance?
2. Does a firm’s strategic orientation with respect to e-commerce have an impact on its performance?

**PROPOSITIONS**

This study develops and tests the following three propositions.

The perceived importance of e-commerce:

*Proposition 1.* There is a positive relationship between a firm’s perception of the importance of e-commerce as reflected in corporate strategy and firm performance.

Market orientation and performance:

*Proposition 2.* Companies that are market oriented will outperform those that are non-market oriented.

A balanced versus a skewed market orientation:

*Proposition 3.* Companies pursuing a balanced market orientation strategy will outperform those pursuing a skewed strategy in the e-commerce market space.

**METHODOLOGY**

This current study used content analysis when examining the CEO’s letter of each firm in the sample. The letter is essentially a status report and a statement of strategy to the company’s shareholders, stakeholders, competitors, and financial
analysts. It reviews the financial position of the company and provides an explanation of the results, discusses major events in the firm, and provides guidance on short and long-term strategies and how they will be implemented. Bowman (1978) demonstrated that “content analysis of annual reports can be of real usefulness for understanding issues of corporate strategy” (p. 96). Further, given that these letters are closely scrutinized, biased or flawed reasoning could lead to severe consequences (Salancik & Meindl, 1984). We can, therefore, use this letter as a representation of a firm’s strategic orientation. Such a method has been successfully used in prior information technology research (Jarvenpaa & Ives, 1990).

**SAMPLE**

The sample frame used was corporations in the Standard and Poor’s 500 Index. This is appropriate, since it reflects a market-value-weighted index (shares outstanding multiplied by stock price) of 500 stocks that are traded on the major exchanges (NYSE, AMEX, and the NASDAQ). The weightings make each company’s influence on the performance of the index directly proportional to that company’s market value. It is this characteristic that has made the Standard and Poor’s 500 Index the investment industry’s standard for measuring the performance of actual portfolios.

A total of nine industries were selected to provide a wide diversity of the potential to use e-commerce: banking, non-banking financial, electronics, retailing, manufacturing, consumer products, fuel, food, and metals and mining. The industries were selected in order to coincide with the Standard and Poor (S&P) and Morgan Stanley Capital International (MSCI) Global Industry Classification Standard (GICS) system. Using a stratified random sampling plan, companies were selected within each industry.

**DATA COLLECTION**

Based on a review of the associated literature (e.g., Applegate, Kalakota, Radermacher & Whinston, 1996; Bakos, 1991; Deshpande, Farley & Webster, 1993; Kambil, Nunes, & Wilson, 1999; Ngai & Wat, 2002; Rigging & Rhee, 1998;
Roberts, 2000; Rust & Zahorik, 1993; Slater & Narver, 1995; Zwass, 1998), three
sets of coding schemes associated with e-commerce, customer-centered strategy,
and competitor-driven strategy were developed.

The terms initially identified from literature sources were not exhaustive;
therefore, two additional steps were taken. First, a panel of six doctoral students
and faculty were asked to classify terms based on definitions of customer and
competitor orientation. Second, an iterative procedure was adopted whereby the
letters were randomly scrutinized for additional terms before final data collection.
Supplementary terms were added based on this procedure.

CONTENT ANALYSIS

Content analysis was defined by Krippendorf (1980) as “a research tech­
nique for making replicable and valid references from data to their contexts” (p.
103). The researcher searches for structures and patterned regularities in the text
and makes inferences on the basis of these regularities. Since this method can be
applied to any piece of writing or recorded communication, content analysis is
used in many fields. Though it was regularly performed in the 1940s, it became a
more credible and frequently used research method after the mid-1950s. Here,
we utilized the three content analyses approaches (i.e., words, concepts, and
semantic relationships) in order to capture the desired information from the
CEO's letters. Year 2000 Annual reports were obtained for each of the firms.
This year was selected because it was an important year in the emergence of
e-commerce. During 1999, it appeared that the financial markets had sus­
pended—at least, temporarily—traditional methods of investment valuation,
resulting in stock prices of companies with no earnings exceeding those who had
real earnings. Then, in 2000, the stock prices began to come into line with their
valuations. At the same time, the perceptions of the Internet and e-commerce, as
an opportunity to fuel innovation, open up alternate distribution channels, create
new cost structures and transform an organization’s competitiveness, were being
solidified in general and particularly in the more traditional companies as they
sought to build e-commerce strategies. Therefore, the CEO statement in the 2000
Annual Report was reflective of initiatives taken by the companies as they sought to position themselves in the e-commerce market.

HALO EFFECT

Proposition 1 argues that the CEO's perception of the importance of e-commerce would lead to better performance. However, it is also possible that well-performing firms (in prior years), having more resources, could positively influence the perception of the importance of e-commerce. To address this concern, a test was conducted for a "financial performance halo effect." Such an effect refers to circumstances where researchers are using secondary proxies to capture constructs of interest and, as a result, may introduce measurement error; if that error is pervasive—a "halo" is said to exist. A halo effect occurs when financial performance variables may affect the validity of research results that use secondary proxies, as may be the case here. Following the procedures in Brown and Perry (1994) a financial performance halo effect was identified and removed in the analysis.

PERFORMANCE MEASUREMENTS

It is widely believed that performance is multi-dimensional in nature and that it is advantageous to integrate different dimensions of performance in empirical studies (Cameron, 1978; Lumpkin & Dess, 1996). Wiklund (1999) regards profitability and growth as different aspects of performance and holds that when combined they give a richer description of the actual performance of the firm. Company-profit growth (CPG) was selected because, in the knowledge economy, strategy must focus on expanding existing markets or creating new ones—not just on beating the competition. However, as time has proved, growth without profitability is not sustainable. Many e-commerce companies had high valuations based on an excessive focus on high growth shown by their attraction of new customers, but their inability to generate profit proved detrimental. Therefore, gross-profit margin (GPM) is a measure of an organization's operating efficiency and, in the new economy, is included as a second measure. The data regarding these performance measurements were collected from the COMPUSTAT database.
CONTROL VARIABLES

In terms of the control variables, we selected industry type and firm size to be included in our model. These factors have a recognized influence on performance. Extant literature has identified a number of industry variables that moderate an organization’s performance (Dess, Lumpkin & Covin, 1997; Slater & Narver, 1994). These variables include: market growth, market turbulence, competitive intensity, and technological turbulence. These situational variables unveil the complexities that exist in various industries; they should be controlled in order to avoid the potential effect on performance. Therefore, industry type was used as a blocking variable to control potential moderators of firm performance. In addition to industry type, firm size is another important factor that could affect a firm’s performance (Barrett, Balloun & Weinsten, 2000).

RESULTS

Due to the large sample size, the normal distribution of the data, and the random selection of the firms used, parametric statistical methods, multiple regression analyses, and analysis of variance (ANOVA) procedures were chosen to test the propositions. Table 1 reports the summary statistics. Ordinary least-squares regression analysis was used to test the first proposition, while ANOVA procedures were employed to test the remaining two propositions.

Table 1. Summary Statistics

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Variables</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gross profit margin</td>
<td>40.95</td>
<td>18.76</td>
</tr>
<tr>
<td>2</td>
<td>Company profit growth</td>
<td>3.27</td>
<td>22.45</td>
</tr>
<tr>
<td>3</td>
<td>Customer-oriented strategy</td>
<td>0.06</td>
<td>0.12</td>
</tr>
<tr>
<td>4</td>
<td>Competitor-oriented strategy</td>
<td>0.13</td>
<td>0.25</td>
</tr>
<tr>
<td>5</td>
<td>Importance of e-commerce</td>
<td>0.27</td>
<td>0.47</td>
</tr>
<tr>
<td>6</td>
<td>Industry types</td>
<td>4.80</td>
<td>2.67</td>
</tr>
<tr>
<td>7</td>
<td>Firm size</td>
<td>2.06</td>
<td>0.83</td>
</tr>
</tbody>
</table>
The first proposition posits a positive relationship between a firm’s perception of the importance of e-commerce and the firm’s performance. As can be seen in Table 2, there was significant support for the first proposition. The regression coefficient for GPM is significant at the 0.001 level and CPG at the 0.01 level, suggesting that the more a firm perceives e-commerce as being important (as reflected in corporate strategy), the more likely it is that the firm will have a higher level of operating efficiency and profitability compared to those firms with a lower perception of importance.

Table 2. Perceived Importance of Electronic Commerce and Performance

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Parameter estimates</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E-commerce</td>
<td>S.E.</td>
<td>N</td>
<td>R²</td>
<td>Adj. R²</td>
<td>F</td>
</tr>
<tr>
<td>Gross profit margin</td>
<td>45.81****</td>
<td>4.09</td>
<td>135</td>
<td>0.31</td>
<td>0.3</td>
<td>20.01</td>
</tr>
<tr>
<td>Company profit growth</td>
<td>11.19***</td>
<td>3.93</td>
<td>132</td>
<td>0.06</td>
<td>0.04</td>
<td>2.75</td>
</tr>
</tbody>
</table>

***p < 0.01

****p < 0.001

Table 3 contains the results of the tests on the impact of a market-oriented strategy on firm performance. For Proposition 2, we expected that companies pursuing a market-oriented strategy would outperform those with a non-market orientation. The results of the post hoc Tukey tests shown in Table 3 support this expectation. The mean differences of the two performance measurements between market-oriented companies and non-market oriented companies are significant at the 0.05 level, suggesting that market-oriented firms perform better than non-market-oriented firms.
Table 3. Market Orientation and Performance

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Tukey studenized range tests&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-2 $H_2$</td>
</tr>
<tr>
<td>Gross profit margin</td>
<td>127**</td>
</tr>
<tr>
<td>Company profit growth</td>
<td>116**</td>
</tr>
</tbody>
</table>

"1" represents companies pursuing a market-oriented strategy; "2" represents companies pursuing a non-market-oriented strategy; "3" represents companies having a balanced-market orientation strategy; "4" represents companies that are skewed to a customer-oriented strategy; "5" represents companies that are skewed to a competitor-oriented strategy.

** $p <0.05$

*** $p <0.01$

**DISCUSSION**

This study sought to investigate how the leaders of traditional companies view the rise of the e-commerce age based on CEO letters contained in corporate annual reports. From our study, we concluded that the e-commerce market space is seen as promising and that it could generate positive-performance implications if it is reflected in corporate strategy. This conclusion is interesting in light of the recent numerous dot-com failures as discussed in the popular press, and it suggests that e-commerce must be given priority in corporate strategy. Brick and mortar companies (which constituted a significant portion of our sample) that incorporate a strategy of this nature would be able to leverage effectiveness and efficiency benefits more effectively. In contrast, if e-commerce is not adopted and integrated at the top, firms may not garner the appropriate resources in order to create the unique capabilities necessary to compete in the virtual market. In such cases, e-commerce could yield a potentially useless appendage to the business.
LIMITATIONS

Certain limitations should be recognized when interpreting our findings. First, this study adopts a cross-sectional research methodology. Thus, caution should be taken in interpreting causality. Second, since the companies are large, questions remain as to the generalizability of this study to medium and small companies. Third, the CEO’s perception concerning the importance of e-commerce may be influenced by the firm’s past performance. Although the relationship between the CEO’s view of e-commerce and firm performance is still positive after removing the financial performance halo effect from the data, we cannot rule out other variables that may influence the CEO’s judgment. Fourth, the partial support for Proposition 3 suggests that high-level financial-performance measures may not reveal the true value of e-commerce initiatives. Intermediate-level performance measures, i.e. inventory turnover, time to market, and product and service quality, may be more appropriate in establishing the relationship between e-commerce strategic initiatives and firm performance.

IMPLICATIONS FOR RESEARCH

This study demonstrates that the CEO’s letter to the shareholders presents a useful research tool for analyzing the relationship between strategy and e-commerce as well as organizational performance. The content-analysis methodology is replicable and can readily be applied to other research questions. Moreover, it provides the means to obtain the perspective of the leaders of organizations in a format that is readily available, longitudinal, and relatively consistent across publicly-held firms. However, firms that are in financial trouble tend to focus their CEO letters on uncontrollable environmental factors. They also might avoid negative statements, lest they disorient the financial markets. Therefore, these letters represent strategic orientation, but are not equivalent to it. Furthermore, complementing this approach with other sources of data, such as surveys and the study of corporate documents, would add richness to the representation of strategy.

In conclusion, this study examined CEO views of e-commerce across a variety of industries and found that e-commerce coupled with a balanced-marketing
orientation, as reflected in these views, is positively related to performance. With e-commerce going through a transitional phase, it is important to seek out relationships that can provide guidance on the future tenor of this phenomenon as it becomes increasingly absorbed into businesses. This study provides a modest step in this direction, alerting interested observers to the importance of tying e-commerce initiatives to corporate strategy and consequently other business resources in order to create distinctive capabilities for competitive advantage.

REFERENCES


PART 3: NORMAN J. ARNOLD
SCHOOL OF PUBLIC HEALTH
MATTERS OF THE HEART AMONG AFRICAN AMERICAN WOMEN

Winifred W. Thompson, MSW

Department of Health Promotion, Education, & Behavior

Norman J. Arnold School of Public Health

Heart disease affects more Americans than any other diseases combined. Cardiovascular disease (CVD), the disease of the heart and blood vessels, is one of the most serious diseases that leads to a high incidence of morbidity and mortality among adults. The two most common forms of CVD are atherosclerosis and hypertensive diseases. Atherosclerosis is the disease of the hardening of the arteries, which is characterized by the formation of fatty deposits, or plaques, in the inner walls of blood vessels (Boyle, 2001). Hypertension is sustained high blood pressure. Along with atherosclerosis and hypertension, there are other forms of CVD: stroke, heart attack, congestive heart failure, arteriosclerosis, peripheral artery disease, and coronary heart disease. CVD, primarily heart disease and stroke, are the nation’s leading killers for both men and women among all racial and ethnic groups. Research now indicates that between 70 and 80 percent of all diseases and illnesses are stress related (Seaward, 2002), with CVD being no exception. With the eradication of infectious diseases of the past, deaths are now characterized by lifestyle diseases, which are diseases whose pathology develops over a period of several years or decades. The purpose of this paper is to address the prevalence of cardiovascular disease within the African American female community through two of its greatest attributable risk factors, hypertension and stress. In addition, primary prevention is presented through holistic health and wellness.

PREVALENCE

More than 61 million Americans have some form of CVD, including high blood pressure, coronary heart disease, stroke, congestive heart failure, and other conditions (Centers for Disease Control & Prevention, CDC, 2002). More than
2,600 Americans die each day of CVD, which is an average of 1 death for every 33 seconds. CVD cost the nation an estimated $329.2 billion in 2002, including health expenditures and lost of productivity (CDC, 2002). In the state of South Carolina, CVD claims the lives of 10,000 individuals each year, which makes it the state’s leading cause of death. In 1998, CVD killed more people in South Carolina than all forms of cancer, pneumonia, influenza, and car accidents combined (South Carolina Department of Health & Environmental Control, SCDHEC, 2002). Cardiovascular disease does not discriminate between women and men; however, women tend to be underdiagnosed and treated less aggressively than men (Chow, Schloss, & Waller, 2001). Researchers have found that although women are less likely than men to develop clinically significant coronary disease prior to menopause, they have equal susceptibility following menopause.

For the past 40 years, CVD has been researched and documented mainly within the male population. For years, CVD was known as the male disease; however, more women and especially older women, after the age of 55 or after menopause, are significantly more at risk of morbidity and mortality associated with heart disease (CDC, 2002). Women who are at least 55 years of age and/or who are experiencing menopause are likely to be diagnosed with CVD. Also women at this age loose estrogen, which serves as a protective factor against CVD. When women loose estrogen while predisposed to other risk factors, they are more prone to develop CVD. In fact, the American Health Association (AHA) states that coronary heart disease and stroke remain as the leading causes of death among women in America and in 1994 accounted for 45.2 percent of all deaths in women (Rose, 1998). In addition, CVD, particularly coronary heart disease (CHD), is the leading cause of death among women aged 60 years and older. CVD deaths, primarily from CHD, out number the next 16 causes of death in women combined, including all cancers (Welty, 2001). Overall, women are 4 to 8 times more likely to die of CVD than of any other disease.

The literature also states that women of color (e.g., African American, Hispanic, Asian, and American Indian women) are at greater risk of CVD and have higher incidences of morbidity and mortality than do their White counterparts.
There have been fewer studies about the prevalence of the disease in women of color than of other groups. In 1998, 3,624 African-Americans died from CVD in South Carolina (SCDHEC, 2002). Heart disease and stroke accounted for 17,965 hospitalizations in 1998 among African Americans, with a total hospitalization cost of more than $267 million in South Carolina (SCDHEC, 2002).

CVD RISK FACTORS

The risk factors for heart disease include lack of physical activity, increased total-blood cholesterol, increased low-density lipoprotein cholesterol, reduced high-density lipoprotein cholesterol, tobacco smoking, high blood pressure, overweight or obesity, and diabetes mellitus (Bell-Wilson, 2002). The CVD risk factors among South Carolina African Americans in 1999 were sedentary lifestyle, overweight, hypertension, high cholesterol, smoking, and diabetes mellitus. The prevalence of CVD risk factors among African American women includes sedentary lifestyle at 68.9% and overweight at 68.5%. These risk factors are followed by hypertension at 31.9%, high cholesterol at 22.5%, smoking at 12.5%, and diabetes at 10.5% (SCDHEC, 2002). Most of these risk factors are modifiable, which can lead to a decrease in the incidence of deaths due to heart disease. This risk-factor modification can be done through participation in regular physical activity, consumption of a low-fat, heart-healthy diet, as well as the reduction and management of stress.

There are co-morbid behaviors/conditions that are likely to lead to CVD such as consuming a high-fat diet, having diabetes mellitus, as well as being obese and having a sedentary lifestyle. Several of the co-morbid risk factors also are linked to other diseases, such as smoking and high blood pressure, hypertension and stroke, obesity and diabetes mellitus. Specifically, in the African American community, the risk factors, co-morbid behaviors, and co-morbid diseases tend to be higher than in other ethnic groups. Despite these numerous risk factors for CVD, this chapter we will focus on only two of the most notable risk factors, hypertension and stress; thus, the other aspects contributing to the development of CVD will not be addressed.
HYPERTENSION

As mentioned earlier, hypertension is sustained high blood pressure, which is attributed to smoking, alcohol consumption, excessive sodium intake, having a sedentary lifestyle, and stress. Hypertension is one of the most prevalent factors of CVD. Persons with hypertension have three to four times the risk of developing CVD than those without high blood pressure. One out of every three African Americans in South Carolina has high blood pressure (SCDHEC, 2002). Some of the signs and symptoms are uncomfortable pressure, fullness, squeezing or pain in the center of the chest that lasts more than a few minutes and is recurring, pain that spreads to the shoulder, neck, or arm, and chest discomfort accompanied by lightheadedness, fainting, sweating, nausea, or shortness of breath (Bell-Wilson, 2002). Some signs and symptoms that may be unique to women are atypical chest, stomach or abdominal pain; recent, unusual shortness of breath during activities or rest; nausea or dizziness without chest pain; unexplained anxiety; weakness or fatigue; feelings of impending doom; back pain; palpitations, and cold sweat or paleness, or upper abdominal pressure or discomfort (Bell-Wilson, 2002).

In the United States, more than 50% of White women and 79% Black women older than 45 years of age have hypertension. This percentage increases to 71% among women older than 65 years of age. After age 65, more women than men have hypertension, in contrast to a reversed prevalence at a younger age. Also, women have more complications due to their hypertension at all ages than men (Orth-Gomer, Chesney, & Wenger, 1998). Hypertension is one of the risk factors that can be hereditary, but it can be controlled by diet, exercise, and by reducing and controlling the amount of stress experienced.

STRESS

Stress is defined as any influence, which disturbs the natural equilibrium of the body, and includes within its reference any physical injury, exposure, deprivation, and all kinds of disease and emotional disturbance (Cox, 1978). Stress is a
factor that affects individuals differently. Although all people experience stress, it appears that differing stressors are perceived in a variety of ways; thus, people experience or react to stress differently. Long-term stress can have a detrimental impact on the functioning aspect of an individual's life. Various stressors tend to take their toll on an individual's capacity to handle various events, which may lead to a weakened-immune system and increased susceptibility to illness and disease. Stress is the collective impact that the rigors of life in modern day America bring to bear on women, such as increased tempo and rapid change, demanding schedules, full-work weeks, child care, single parenting, and commuting (Reisman, 1998).

Lerman and Glanz (1997) refer to three types of stressors that individuals experience: life events, chronic strains, and daily hassles. Life events are discrete one-time occurrences that individuals experience (e.g., death, marriage, births, loss of employment). Chronic strains are ongoing in nature and require long-term responses (e.g., long-term personal illness, care of a family member), and daily hassles are the minor difficulties and uplifts (e.g., parenting, work issues, family responsibilities). The daily hassles exert a cumulative influence on health and one's overall well-being. These multiple stressors can bombard the immune system and over time can weaken one's resistance to becoming ill.

Furthermore, role strain consists of the variety of roles that an individual assumes along with the multiple demands of those roles. In the author's experience with clients in the social-work field, role overload is a type of role strain that specifically exists among women. Being employed outside of the home while serving as the primary caretaker of children as well as holding responsibilities in the church and community can all be pleasurable experiences, but without a support system or a periodic break, women are left feeling overwhelmed with their responsibilities. All of the stressors combined create pressures that can induce physical and mental anguish.

Hypertension is directly related to stress. The central-nervous system, endocrine system and stress hormones are responsible for elevated-blood pressure leading to coronary heart disease (Seaward, 2002). If the stress-related hor-
mones are released into the bloodstream due to the “fight-or-flight” response or the continual mode of being overstressed due to chronic strains with life events and daily hassles, then the agents can increase the heart rate and myocardial contractility in order to cause the heart to pump a greater supply of oxygenated blood to the body's muscles for energy production (Seaward, 2002).

Stress over time can be a constant wearing force on an individual. Individuals have varying abilities to withstand stress through the use of coping mechanisms. When an individual's coping resource has been depleted, it is not known how to replenish it (McQuade, 1974). Therefore, stressors within the individual are events or series of events that demand immediate attention to control. The pile-up of these stressors without any emotional, social, or physical outlet can cause a person to become ill. With the challenges and struggles of sexism, racism, ageism, and classism that exist, women face a great challenge in taking care of themselves, physically, mentally, socially, and spiritually. These challenges coupled with co-morbid conditions and lifestyle-risk factors make CVD prevention particularly challenging for African American women.

ADDRESSING PRIMARY PREVENTION THROUGH HOLISTIC HEALTH

In the prevention of CVD, it is extremely important for women, preferably as young girls, to be aware of the risk factors of CVD. It is equally important to recognize the symptoms of CVD, specifically the symptoms for women. It also is pertinent to have a holistic approach to achieving health. A balance in healthy mind, body, and spirit can offset stress with counter measures, such as rest, meditation, therapy or recreation (Reisman, 1998). The mind, body, and spirit are interrelated and interconnected. Achieving total health is not merely through personal changes, but it also is accomplished through education about predisposing and environmental factors that can influence one's health. Race is an important variable in the biologic and social aspects of hypertension; however, evidence suggests that social disparities between African Americans and White Americans have far
more influence over disease prevalence than do genetic differences (Sowers, Ferdinand, Bakris, & Douglas, 2002).

Predisposing factors are factors to which an individual is exposed merely through birth or prior to any experience; the individual often times has no control over the exposure (e.g., a parent is diagnosed with diabetes then the child has a greater risk of being diagnosed with the diabetes). A large number of biologic variables are thought to be related to the greater prevalence and high morbidity rate of hypertension in African Americans compared with White Americans (Sowers, et al., 2002). Environmental factors are factors to which an individual is exposed from one's environment/community. It seems clear that, an individual may or may not have control over this factor due to economics, poverty, culture, etc. (e.g., an individual is asked by her doctor to eat more fresh fruits and vegetables but the individual has no transportation and the grocery store closest to that person has a limited amount of fresh vegetables and fruits). Examples of social/environmental/economic variables are access to health care, access to health-care information, level of education, employment status, income, neighborhood of residence, and the use of medical procedures. Some examples of biologic or genetic variables are body mass index, cardiovascular reactivity, salt sensitivity, vascular resistance, and waist circumference (Sowers, et al., 2002).

Achieving mental and spiritual health will contribute to an individual's physical and social health. Establishing a holistic approach to health that is culturally sensitive and includes a well-balanced diet, regular exercise, positive affirmations, prayer, meditation, as well as having a support system, and indulging in self-love can create an environment that will foster a proactive stance to achieving optimal health.

The issue of primary prevention also should be addressed within the aspect of creating an environment for women that is more assessable, attainable, and a part of everyday life. “Communication is both the most basic and the most powerful vehicle of health care” (Roter & Hall, 1997, p. 206). Roter and Hall indicate that patient-provider communication is one additional area that should be addressed in increasing a patient's compliance with health-care recommendations; thus, communication between two or more persons is essential to accomplishing any goal.
that is set forth. Communication is the piece that joins the patient with the
provider; therefore, the patient-provider relationship forms the basis of treatment.
The type of relationship perceived by the patient can set the tone for the diagnosis
and treatment. Factors that may influence effective patient-provider communica-
tion are power/expertise, life-cycle, socio-economic differences, race and ethnicity,
gender, patient's needs, societal values, and social norms (Roter & Hall, 1997). If
communication is effective, then it is likely that the appropriate treatment will be
accepted and followed. Based on a thorough review of the literature one can con-
clude that if there is a two-way communication with opportunities to share openly
about concerns and ideas, then the patient is more likely to enjoy the consultation
and trust the provider. Therefore, in patient-provider communication, it is impera-
tive to have clear, concise communication that is appropriate and sensitive for per-
sons of a specific age, gender, ethnicity, or class.

Communities can continue to be proactive in addressing the issue of health
and wellness by providing opportunities for women to love and take care of them-
selves. Churches, neighborhoods, schools, businesses, community organizations,
as well as the medical community should be promoting the same message of
practicing preventative care. If women were to have the same quality information
and support in all of the above-mentioned entities, there would be a collaborative
and concerted effort in not only reducing the rate of CVD but also in reducing
health disparities. If all of these entities were united in their approach to reduc-
ing the rate of CVD in the African American-female community, it would lead to a
more aggressive approach on the individual, community, organizational, and polit-
ical levels for making systemic changes (Pargee, Lara-Albers, & Puckett, 1999).

HOLISTIC HEALTH

Wellness encompasses the balance, integration, and harmony of the physical,
intellectual, emotional, and spiritual aspects of the human condition (Seaward,
2002). Seaward indicates that treating the individual holistically means that it is
impossible to treat the physical body and not treat the mind, emotions, or spiritual
well-being. Further, the primary focus of wellness is the prevention of disease and
illness and the enhancement of health. The health of the individual is interde­pendent with the health of the family, the community, and the environment (Pargee, et al., 1999).

The medical paradigm is a focus on symptoms of dysfunction that physicians are trained to fix or replace through prescription, surgery, and transplants. In many cases, physicians often disregard how the physical body connects with the mental, emotional, and spiritual aspects of well-being. The components of the wellness paradigm include mental (intellectual) well-being, which is regarded as the ability to gather, process, recall, and exchange (communicate) information. Physical well-being generally is described as the optimal functioning of the body's major physiological systems (e.g., cardiovascular, digestive, etc.). Also, emotional well-being can be defined as the ability to feel and express the full range of human emotions and to control them rather than be controlled by them. Similarly, spiritual well-being is described as the maturation of higher consciousness through strong nurturing of relationships with both self and others, the development of a strong personal value system and a meaningful purpose in life (Seaward, 2002).

The holistic perspective is to effectively deal with stress and disease through all of the areas of the wellness paradigm. Holistic health addresses the root causes of stress as opposed to treating merely the symptoms and having a band-aid effect on the illness. The inclusion of cultural influences on health acts as a positive force by joining communities to promote community wellness, weaving cultural wisdom into health promotion (Pargee, et al., 1999). Through this author's experience in the social work and public-health fields, addressing health holistically produces long-term sustained change in individuals. Individuals can be prescribed medication, but the cost and compliance may be factors quite important to successfully controlling hypertension and reducing stress. Holistic health addresses lifestyle changes such as modifying behaviors through developing coping skills.

COPING TECHNIQUES

Holistic health and wellness includes a variety of coping mechanisms in reducing the risk factors of CVD. Specifically, with hypertension and stress, an
individual approach is needed to address the various stressors any individual is experiencing. Once the stressors are identified, then a focus is placed on utilizing a variety of coping mechanisms. The wellness paradigm suggests that there be a collaborative integration of several therapeutic techniques to produce the most effective healing process (Seaward, 2002). The use of relaxation techniques such as diaphragmatic breathing, meditation, mental imagery, biofeedback, and others should be used in conjunction with a variety of coping strategies such as behavior modification, journal writing, time management, cognitive restructuring, and others (Seaward, 2002). Incorporating social support also is important to include as a coping technique in preventing depression, stress and hypertension. Social isolation and lack of social support are closely linked to depression (Orth-Gomer, et al., 1998). These factors have been shown to increase cardiovascular mortality risk in men and women. Providing supportive social networks, strengthening social ties, and improving social competence offer opportunities to counter this stress and improve the quality of life for both individuals and society at large (Orth-Gomer, et al., 1998). A comprehensive approach to wellness does not attempt to merely reduce (i.e., fix or repair) stress but rather to manage it efficiently (Seaward, 2002). This approach attempts both to resolve the causes and to reduce or eliminate the symptoms.

RECOMMENDATIONS

In order to prevent cardiovascular disease, women should be aware of their individual risk factors, understand the effects of the disease as well as how that relates to their quality of life. There are social, biologic, and environmental disparities between African Americans and Whites; such differences are reflected in poorer cardiovascular health outcomes for African Americans. While this knowledge is not new, it is time for young girls and women to be proactive about receiving the quality care that they need and deserve, while they also are tuning in to the signals of their bodies. It is time for organizations and communities to take responsibility while being proactive about delivering quality care to culturally-diverse communities. Both the individual and the community should make con-
certed efforts to reclaim the basis in healing and achieving total health and wellness through mind, body, and spirit.

REFERENCES


PART 4: COLLEGE OF EDUCATION
A COMPARISON OF TWO METHODS OF ESTIMATING EFFECT SIZE WHEN MISSING DATA ARE PRESENT

Dorinda J. Gallant-Taylor
Department of Educational Psychology
College of Education

Missing data are fairly common in empirical research, and over many years, statisticians have devised ways to handle them in data analysis. There are a variety of techniques available. Some of these techniques include listwise deletion, pairwise deletion, mean substitution, regression methods, hot-deck imputation, and multiple imputation. Until recently, the most widely used methods have involved removing the missing values either by ignoring the subjects with incomplete information or by substituting values for the missing data (Schafer & Olsen, 1998). Within the last ten years, there have been additional studies conducted that compared missing data techniques (e.g., Hegamin-Younger & Forsyth, 1998; Kromrey & Hines, 1991; Ward & Clark, 1991; Witta & Kaiser, 1991). The comparisons have yielded differing conclusions as to which technique produces the most accurate estimates when data are missing.

Part of traditional statistical inference is the focus on an analysis for statistical significance (e.g., p-values); however, it is also important for researchers to consider effect-size estimators. Effect-size estimators provide the reader with a concept of the practical magnitude of the results. Wilkinson and the APA Task Force on Statistical Inference (1999) indicates two important aspects of reporting and interpreting effect sizes: (a) readers are able to evaluate the stability of results across samples, designs, and analyses, and (b) interpreting effect sizes is critical for future research where power analysis and meta-analysis may be needed. In addition, when researchers know the effect size of a study, this information can be helpful in determining an appropriate sample size for follow-up studies (Hyde, 2001).
The insistence upon reporting effect sizes is not the sole responsibility of one individual. It is also the responsibility of journal editors, textbook authors, and publication manuals (Hyde, 2001; Vacha-Haase, 2001). However, this does not exclude university and college professors, who are preparing the next generation of researchers. There is a need for academia to stress to students the importance of reporting the magnitude of a study, in addition to reporting the p-values, where statistical significance is observed.

**PURPOSE OF THE STUDY**

The purpose of this study is to investigate empirically an effect-size estimator, Cohen's (1988) \(d\), when data points are missing from a survey. Cohen's \(d\) measures the standardized difference between group means. Two missing-data treatments (i.e., listwise deletion and item-mean substitution) were used to compute the estimator for a real-data set. Results were compared using these two missing-data treatments, and conclusions were reached regarding the method that is most efficient.

The research questions of interest are:

1. Are there statistically significant differences in male and female responses on the phonics, skills, and whole language scales when data points are missing at 10%, 20%, and 30%?
2. When statistically significant differences in male and female responses are detected on the three scales of an existing data base, how large are these differences?
3. Which of the two missing data treatments (i.e., listwise deletion or item-mean substitution) is more efficient at handling missing data points at 10%, 20%, and 30%?
METHOD

Missing Data Treatments

Missing data were treated as missing at random. Kline (1998) describes data that are missing at random as “the probability of the presence versus absence of scores on some variable is unrelated to subjects’ true status on that variable” (p. 73). In other words, missing at random assumes no systematic pattern to which subjects did not respond to items.

In the original data set, only about 7% of the participants omitted one or more responses to an item. Missing data were handled using listwise deletion and item-mean substitution. Listwise deletion is the process of deleting cases with one or more missing data points for the items. This procedure allows use of only complete records in examining effect size. Item-mean substitution is the process of replacing omitted item responses by the mean of the item; thus, data are analyzed for all participants in the study.

Data

The present study used data collected by the South Carolina Reading Initiative (SCRI). The SCRI is a three-year, statewide-intensive staff-development effort designed to improve the reading skills and strategies of children. These staff-development efforts include increasing teachers’ knowledge about reading research and providing teachers with the administrative and in-class support they need to be consistent with reading research.

The Theoretical Orientation for Reading Profile (TORP) (DeFord, 1985) was administered to 2,009 SCRI participants in the Fall of 2000. SCRI participants were statewide elementary teachers (K – Grade 5). The instrument was administered and collected by SCRI coaches. There were 1,952 respondents [95 (4.9%) males and 1,857 (95.1%) females] to the TORP instrument; thus, the response rate was 97.2%. The internal consistency of the instrument was $\alpha = .79$.

The TORP consists of 28 statements on theoretical orientation to reading.
instruction. Each statement on the TORP is accompanied by a five-point Likert scale ranging from 1 (Strongly Agree) to 5 (Strongly Disagree). These statements comprise three scales: phonics, skills, and whole language (DeFord, 1985).

Table 1 presents the characteristics and percentage of missing data for the three scales used for this research. The phonics scale consists of 10 items relating to beliefs and practices in phonics orientation to reading. The skills scale consists of 10 items relating to beliefs and practices in skills orientation to reading. The whole language scale consists of eight items relating to beliefs and practices in whole-language orientation to reading.

Table 1. Characteristics and Percentages of Missing Values of the Likert-Type Scales

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Phonics</th>
<th>Skills</th>
<th>Whole Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of items</td>
<td>10</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>In original sample of $N = 1,952$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.09</td>
<td>2.85</td>
<td>2.95</td>
</tr>
<tr>
<td>SD</td>
<td>.57</td>
<td>.48</td>
<td>.58</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>.780</td>
<td>.60</td>
<td>.58</td>
</tr>
<tr>
<td>Percentage of cases missing</td>
<td>3.89%</td>
<td>1.84%</td>
<td>2.77%</td>
</tr>
<tr>
<td>In sample of complete cases $n = 1,813$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.09</td>
<td>2.85</td>
<td>2.94</td>
</tr>
<tr>
<td>SD</td>
<td>.57</td>
<td>.48</td>
<td>.58</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>.71</td>
<td>.60</td>
<td>.58</td>
</tr>
</tbody>
</table>

**DATA ANALYSIS**

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) v.10 for Windows. From the data set of 1,952 respondents, only the 1,813 respondents [91 (5%) males and 1,722 (95%) females] who had complete records were used in the analysis. Missing values were randomly assigned to
each of the three scales for three treatment conditions: missing values of 10%, missing values of 20%, and missing values of 30%.

The analyses were conducted in four phases. The first phase of analysis was to examine the effect sizes for differences in means for male and female respondents for the complete data set of 1,813 cases, simulating a typical educational-research study. In phases two through four, analysis involved using the complete data set of the 1,813 respondents and randomly assigning missing values for 10%, missing values for 20%, and missing values for 30% of the responses on each scale. Then, listwise deletion and item-mean substitution were used to examine effect sizes for differences in means for male and female respondents.

Cohen's $d$ (1988)

\[
d = \frac{\overline{x}_1 - \overline{x}_2}{s_1 + s_2}
\]

Cohen's conventions describe effect sizes as (a) small, if $d = .20$; (b) medium, if $d = .50$; and (c) large, if $d = .80$, when t-tests are used for the analysis.

In all phases of analyses an independent t-test was conducted to compare mean responses of male and female respondents on the three scales. The dependent variables were the mean responses on each scale (phonics, skills, and whole language). The independent variable was gender. The alpha level was set at .05 for the independent t-test. However, to control for the experimental-wise error rate, a Bonferroni correction of .0167 ($\alpha/3$) was used for each comparison, which is a procedures that is typically used in an educational-research study to control for Type I experiment-wise error.

Twenty of the items (i.e., 10 items on the phonics scale and 10 items on the skills scale) are stated negatively in terms of instructional practices for the SCRI. The eight whole language scale items are stated in a positive manner. These positively stated practices were recorded before analyses were done to be consistent with negatively stated SCRI beliefs and practices.
RESULTS

Phase I: Complete Data Set

Using the complete data set, an independent t-test indicated statistically significant mean differences between male and female responses on all the scales [phonics: \( t(1,811) = 3.606, p < .0001; \) skills: \( t(1,811) = 3.019, p < .003; \) whole language: \( t(1,811), p < .013 \)]. The computed effect sizes are presented in Table 2. As indicated in the table, the effect size for the mean differences on the phonics scale (ES = .430) is larger than the effect sizes on the skills (ES = .334) and whole language (ES = .283) scales. Based on the previously described conventions, the effect sizes for all three scales are classified as “small.” This indicates that there is not a great departure from a null hypothesis of no difference in male and female responses on the scales.

Table 2. Effect Sizes of Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Scale</th>
<th>10% Missing Scale Values Effect Size*</th>
<th>20% Missing Scale Values Effect Size*</th>
<th>30% Missing Scale Values Effect Size*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete cases ((n = 1,813))</td>
<td>Phonics</td>
<td>.430</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skills</td>
<td>.334</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole</td>
<td>.283</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listwise deletion ((n = 1,279) ( n = 933 ) ( n = 630 ))</td>
<td>Phonics</td>
<td>.366</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Skills</td>
<td>-</td>
<td>-</td>
<td>.497</td>
</tr>
<tr>
<td></td>
<td>Whole</td>
<td>.344</td>
<td>-</td>
<td>.505</td>
</tr>
<tr>
<td>Item Mean Substitution ((n = 1813) ( n = 1800) ( n = 1758))</td>
<td>Phonics</td>
<td>.382</td>
<td>.348</td>
<td>.401</td>
</tr>
<tr>
<td></td>
<td>Skills</td>
<td>.287</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Whole</td>
<td>.308</td>
<td>.307</td>
<td>.354</td>
</tr>
</tbody>
</table>

Note: *Effect sizes are only reported where statistically significant differences were found between male and female responses on the scales.
Phase II: Analysis with 10% of Missing-Data Points

**Listwise Deletion Procedure.** Ten percent of mean scale responses were randomly deleted. Using only cases with no missing data points \( n = 1,279 \) (66 (5.2%) males and 1,213 (94.8%) females), an independent \( t \)-test indicated significant mean differences between male and female responses on the *phonics* and *whole language* scales \( t(1,277) = 2.592, p < .010 \) and \( t(1,277) = 2.544, p < .011 \), respectively]. There were no significant differences between male and female responses on the *skills* scale \( t(1,277) = 2.082, p < .038 \). The effect size for the mean difference on the *phonics* scale \( (ES = .366) \) is larger than the effect size for *whole language* scale \( (ES = .344) \); however, these effect sizes are classified as “small.”

**Item-Mean Substitution Procedure.** Using the complete data set, 10% of mean scale responses were randomly deleted. Then, the deleted responses were replaced with the corresponding scale mean. The number of respondents used in the analysis was 1,813. An independent \( t \)-test indicated significant mean differences between male and female responses on all the scales \( [phonics: t(1,811) = 3.171, p < .002; skills: t(1,811) = 2.591, p < .010; and whole language: t(1,811) = 2.706, p < .007] \).

The effect size for the mean differences on the *phonics* scale \( (ES = .382) \) is larger than the effect sizes for *skills* \( (ES = .287) \) and *whole language* \( (ES = .308) \) scales. The effect sizes are all classified as “small.”

Phase III: Analysis with 20% of Missing-Data Points

**Listwise Deletion Procedure.** After randomly deleting 20% of mean scale responses and using only cases with no missing data points \( n = 933 \), an independent \( t \)-test revealed no significant mean differences between male and female responses on all three scales \( [phonics: t(931) = 1.885, p < .060; skills: t(931) = 1.560, p < .119; whole language: t(931) = 1.411, p < .159] \). Since there were no significant effects, effect sizes were not computed.
**Item-Mean Substitution Procedure.** Twenty percent of the mean-scale responses from the complete data set, as previously described, were randomly deleted. The deleted responses were then replaced with the corresponding scale mean. Since there were 13 cases where all three scales had missing data points, only 1,800 respondents were used in this analysis. Significant gender response-mean differences were noticed on the *phonics* and *whole language* scales

\[ t(1,798) = 2.979, p < .003 \text{ and } t(1,798) = 2.736, p < .006, \text{ respectively} \].

There was no significant gender response-mean difference on the *skills* scale \[ t(1,798) = 1.728, p < .084 \]. Although the effect size for mean differences on the *phonics* scale (ES = .348) is larger than the effect size for *whole language* (ES = .307), the effect sizes are “small.”

**Phase IV: Analysis with 30% of Missing-Data Points**

**Listwise Deletion Procedure.** After deleting 30% of scale mean responses and using only cases with no missing-data points \( n = 630; 31 (4.9\%) \text{ males and 599 (95.1\%) females} \), an independent *t*-test indicated significant mean differences between male and female responses on the *skills* and *whole language* scales \[ t(628) = 2.608, p < .009 \text{ and } t(628) = 2.569, p < .010, \text{ respectively} \]. There was no significant-mean difference between male and female responses on the *phonics* scale \[ t(628) = 2.017, p < .044 \].

The effect size for the mean differences on the *whole language* scale (ES = .505) is larger than the effect size for *skills* (ES = .497). These effect sizes are classified as “medium” and “small,” respectively. The classification of “medium” indicates a greater departure from a null hypothesis of no difference in male and female responses on the *whole language* scale.

**Item-Mean Substitution Procedure.** Using the complete data set, as described above, 30% of mean scale responses were deleted; and the deleted responses were then replaced with the corresponding scale mean. The number of respondents used in the analysis was 1,758. The number reflects 55 cases deleted due to missing values on all three scales. Statistically significant gender response-mean differences were observed on the *phonics* and *whole language* scales.
There was no significant mean difference between male and female responses on the skills scale \( t(1,756) = 1.669, p < .095 \). The effect size for the mean differences on the phonics scale (ES = .401) is larger than the effect size for whole language (ES = .354); however, both effect sizes are classified as “small.”

**DISCUSSION AND CONCLUSION**

The presence of missing data is common in research. It is prevalent in survey data, where there typically is a large number of participants and a large number of items. How researchers handle missing data is important to the credibility of the results of the research as well as to the credibility of the researchers.

There are a number of ways of handling missing data. These include listwise and pairwise deletion and various imputation procedures (i.e., item-mean substitution, hot deck, and regression). Determining which of these methods is best for handling missing data has been the center of controversy among researchers. Hegamin-Younger and Forsyth (1998) found, in a study involving a comparison of four imputation procedures in a two-variable prediction system, that the best method of imputation depended on the nature of the analysis. For different analyses, different methods of handling missing data give a better estimate of the parameter of interest.

Not only is it important to decide on a method of dealing with missing data, it also is important to report the effect size of the study to readers. The significance of the results of the study reported in isolation provides only a small picture of the entire study. Readers and researchers can both benefit from knowing the effect size of the study. Readers will be provided insight into the magnitude of the study. Researchers can use the information for designing future studies.

In tests of the research questions for this study, statistically-significant differences were found in male and female responses on most of the three scales. For the complete data set, there were significant gender differences on all three scales; however, the differences do not reflect a substantial departure from a null hypothesis of no significant gender differences in scale responses since effect sizes
are small. Similar results were found when item-mean substitution was used with 10% of the data points missing. However, when listwise deletion was used with 20% of the data points missing, there were no significant gender differences found on any of the three scales.

There was only one moderate departure from a null hypothesis of no significant gender-response difference, in tests of the second research question. The medium effect size was found when using listwise deletion with 30% of the data points missing on the whole language scale. In all other treatments and levels of sample size the differences in the responses of male and females on the scales was significant on question one, but effect sizes were small, meaning they were close to the null hypothesis of no significant differences in responses.

For this study, the best method for handling missing data appears to be item-mean substitution. Item-mean substitution seems to replicate the findings of the complete data set when 10% of the data are missing on all three scales. In addition, findings for the complete data set are also replicated for the phonics and whole language scales when 20% and 30% of data points are missing. The use of listwise deletion does not do as good a job of replicating the complete data set; thus, the results of this study affirm the use of item-mean substitution as the best approach to handling missing data in educational research similar to this data set.

REFERENCES


Disproportionality has emerged as an elusive, dynamic construct, one that has brought considerable angst to a number of school districts. Approximately 1.5 million minority children were identified and labeled as having mental retardation (EMR), emotional disturbance (ED) or specific learning disability (SLD) labeled at a rate of 2.9, 1.9 and 1.3 times, respectively, more than White students in a report by the U.S. Department of Education (DOE), Office of Special Education Programs, Data Analysis System (DANS) (USDOE, 2000). Further noted in the report was that African Americans age 6-21 represent 14.8% of the resident or general population while representing 20.2% of all disabilities in the country’s schools.

States have been wrestling with and litigating the issue of disproportionality for almost three decades (e.g., Johnson v. San Francisco Unified School District, 1974; Larry P et al. v. Wilson Riles et al., 1979; Marshall et al. v. Georgia, 1984, 1985; Lee v. Macon County Board. of Education 1967, 1998). Yet, despite this long history of concern, states have been unable to implement effective responses leading to more equitable educational experiences and acceptable outcomes for minority children (Harry & Anderson, 1995). As such, the Federal government in the reauthorization of the Individuals with Disabilities Education Act (IDEA) stipulated that states had to begin a data-collection process (DOE Code of Federal Regulations, 1999).

Once the states developed an adequate method for capturing the necessary data, the next step of this process is defining disproportionality. That is, each state must determine what is revealed in the data about disproportionality and use this
information to formulate an appropriate and meaningful definition. States are struggling with this process of defining disproportionality. Even though the Office of Civil Rights (OCR) has been monitoring the process, OCR has offered no guidelines to states as to what constitutes disproportionality. However, as a means of providing consistency in reporting across all states, guidelines are contained in the general instructions for completing the Biennial Performance Report using a .2 factor (DOE Code of Federal Regulations, 1999). Thus, the purposes of this monograph chapter are to explore: (a) the historical development of the concept of disproportionality, (b) how states have developed their definitions of disproportionality, and (c) the implications for the future.

**DISPROPORTIONALITY AND OVERREPRESENTATION**

Used interchangeably in the literature, disproportionate representation and overrepresentation have remained increasing concerns for educators despite some distinctive differences. Disproportionality may result from the oftentimes erroneous or inappropriate referrals and assignment of African Americans to special education in disproportionate numbers (National Alliance of Black School Educators, 2002). Reschly, Kicklighter, and McKee (1988) stated that in defining overrepresentation, three variables should be examined: (a) percentage of total-student enrollment by group, (b) percentage of special-program enrollment by group, and (c) percentage of group in the special program in question. Harry (1994) added that it was about relative, not absolute numbers, stating that over-representation occurs when the percentage of minority students in the program is larger than the percentage of that group in the educational system as a whole. Another important, underlying issue present in overrepresentation is the construct of underrepresentation, where racial/ethnic groups find themselves under-represented in certain categories based upon their numbers in the population (Lee v. Macon County Bd. of Education, 1967). Regardless of which term is used, the quandary remains for the states to develop a definition that is both adequate and effective in addressing the issue of overrepresentation.
Early Legal Challenges to Disproportionality

Over the years, a number of theories (or reasons) have surfaced to explain why disproportionality exists. Historically, these explanations have resulted in examining many aspects of the education and special-education system, including the quality of instruction prior to referral, decisions to refer, assessment and placement of students in special-education programs, and the quality of instruction that occurred in the program (Harry & Anderson, 1995). Oswald, Coutinho, and Best (2002) extended the examination of the explanations of disproportionality by questioning whether or not there might be a relationship between demographic, fiscal, and school-related variables as possible predictor variables for disproportionality.

**Early legal challenges.** The overrepresentation of African American males in special education has been a longstanding issue for over three decades. Early on, the issue of disproportionality focused on segregation. Brown v. Board of Education of Topeka, Kansas (1954) held that segregation was in violation of the Due Process Clause of the 14th Amendment of the Constitution. Due to the relatively large percentages of minority students in special education, cases examining disproportionality have taken this constitutional approach. Cases involving disproportionality have relied on the argument of segregation and a test of "unlawful segregative intent" as a way of attacking the disproportionate placement of African American males in special education (Larry P. et al. v. Wilson Riles et al., 1979; Marshall et al. v. Georgia, 1985; and Lee v. Macon County Board of Education, 1967, 1998). The issue of race-based disproportionality in special education was finally addressed through legislation during the reauthorization of the Individuals with Disabilities Education Act as a possible result of past litigation (DOE Code of Federal Regulations, 1999).

**The IDEA and Disproportionality.** The IDEA emerged as the federal law that guarantees students with disabilities the right to free and appropriate education in the least restrictive environment. It was reauthorized, in part, to address race-based disproportionality in special-education programs.
Section 300.755 of the DOE Code of Federal Regulations (1999) reads:

300.755 Disproportionality

(a) General. Each state that receives assistance under Part B of the Act, and the Secretary of the Interior, shall provide for the collection and examination of data to determine if significant disproportionality based on race is occurring in the State or in the schools operated by the Secretary of the Interior with respect to;

(1) The identification of children as children with disabilities, including the identification of children as children with disabilities in accordance with a particular impairment described in section 602(3) of the Act, and

(2) The placement in particular educational settings of these children.

(b) Review and revision of policies, practices, and procedures. In the case of a determination of significant disproportionality with respect to the identification of children as children with disabilities, or the placement in particular educational settings of these children, in accordance with paragraph (a) of this section, the State or the Secretary of the Interior shall provide for the review and, appropriate, revision of the policies, procedures and practices used in the identification or placement to ensure that the policies comply with the requirements of Part B of the Act(20 U.S.C. 1418(c)).

Since the issue of disproportionality is addressed in a United States (U.S.) Code, it is under the jurisdiction of the U.S. Department of Education Office of Civil Rights (OCR). Even though the statutory intent of the law was clear, OCR has not suggested specific policy guidelines to the states in developing an appropriate definition.

Disproportionality and the States. The IDEA stipulates that the states must collect data, determine if disproportionality exists, and take appropriate action to ameliorate the condition. Therefore, the issue facing the States is what
constitutes significant disproportionality? The Federal Register (Fed. Reg.) includes regulatory guidance in the form of non-binding regulation. The determination of disproportionality stipulated in this non-binding regulation involves consideration of a wide range of variables peculiar to each State. These variables should include income, education, health, cultural, and other demographic characteristics in addition to race. Therefore, if OCR prescribed how the States should determine disproportionality and take corrective action, it would not reflect the varied circumstances existing in each State and would be inconsistent with discretion afforded the States under the statute (Federal Register, 1999, Vol.64, No. 48, P. 12651-12652). Given the lack of guidance from OCR, the quandary faced by the states was shaping their respective definitions of disproportionality and corrective procedures necessary for amelioration.

DEFINING DISPROPORTIONALITY ON THE STATE LEVEL

It is beyond the scope of this paper to determine the process each state is using to define disproportionality. Some States already have made an effort to define the construct of disproportionality. After examining criteria used by the states to determine disproportionality, the National Association of State Directors of Special Education (NASDSE) released a study in which the prospective criteria used by each state are outlined (Markowitz, 2002). Markowitz noted in the findings that 29 states have specific criteria for disproportionality, with 26 states having a single criterion and three having multiple criteria. Additionally, it was noted that the most common criteria were either the percentage-point discrepancy or a significance test (Markowitz, 2002). The state criteria for determining disproportionality for 29 states are contained in Table 1.

Percentage-Point Discrepancies and Similar Criteria

Ten states including Arkansas, Indiana, Iowa, Massachusetts, Michigan, Nevada, New Jersey, North Carolina, Pennsylvania and Tennessee use a percentage-point discrepancy that consists of:
• Calculating the percentage of each racial/ethnic group in the total student population.

• Calculating the percentage of each racial/ethnic group in each disability category.

• Applying the percentage point discrepancy determined by each state above and below the total population percentage to identify an acceptable range of representation.

• Comparing the categorical percentage to the population range to determine if disproportionality exists.

For example, if African Americans represented 30% of the student population, 40% of the students in emotional disability classes, and the state had a point discrepancy of eight, the interval between 22 and 38 percent would indicate an acceptable range. The above example indicates a disproportionality issue of approximately two percentage points. The state percentage point discrepancies as indicated in Table 1 range from a low of "≥3" in Indiana to "≥20" in Tennessee.

Four states used a slightly different discrepancy criteria based on percentages or raw numbers. The criterion for disproportionality in Connecticut is determined when the actual prevalence was less than one half or more than two times that racial/ethnic group’s representation in the total-student population. The criterion for overrepresentation in West Virginia was two times the percentage of students in a racial/ethnic group found in the school district’s total enrollment. Delaware, using .2, actually mirrors the Federal Government’s choice in percentage of a racial/ethnic group in the total population being calculated and multiplied by .2 (DOE Code of Federal Regulations, 1999). That product reflected as a percentage was the maximum percentage-point discrepancy. This process determined the actual-point discrepancy in contrast to the initial ten states that determined their own point discrepancies. The point discrepancy was determined by multiplying .2 by the percentage of the racial/ethnic group that existed in the total population. Criterion in Virginia was similar to that of Delaware, the only difference being Virginia’s use of raw numbers as opposed to percentages.
### Table 1. State Disproportionality Criteria (N = 29)

<table>
<thead>
<tr>
<th>State</th>
<th>Nature of Current Criteria</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>Odds ratio ≠ 100</td>
<td></td>
</tr>
<tr>
<td>Arkansas</td>
<td>Discrepancy &gt; 8.5 percentage points</td>
<td>Not applied if LEA is 95% minority or 95% white</td>
</tr>
<tr>
<td>California</td>
<td>E Formula (description in paper)</td>
<td></td>
</tr>
<tr>
<td>Colorado</td>
<td>Statistical test of significance based on t distribution</td>
<td>p &gt; .05</td>
</tr>
<tr>
<td>Connecticut</td>
<td>&lt; .5 or &gt; 2 times the expected prevalence</td>
<td>Cell size must be &gt; 14</td>
</tr>
<tr>
<td>Delaware</td>
<td>&gt; 20% variation from the population prevalence</td>
<td></td>
</tr>
<tr>
<td>Idaho</td>
<td>E formula</td>
<td></td>
</tr>
<tr>
<td>Indiana</td>
<td>Discrepancy ≥ 3 percentage points</td>
<td></td>
</tr>
<tr>
<td>Iowa</td>
<td>Discrepancy ≥ 10 percentage points</td>
<td></td>
</tr>
<tr>
<td>Maryland</td>
<td>Chi-square test of significant difference</td>
<td></td>
</tr>
<tr>
<td>Massachusetts</td>
<td>Discrepancy ≥ 10 percentage points</td>
<td></td>
</tr>
<tr>
<td>Michigan</td>
<td>Discrepancy ≥ 5 percentage points</td>
<td></td>
</tr>
<tr>
<td>Minnesota</td>
<td>(See text)</td>
<td></td>
</tr>
<tr>
<td>Mississippi</td>
<td>Difference of ≥ 2 standard deviations</td>
<td></td>
</tr>
<tr>
<td>Missouri</td>
<td>Chi-square test of significant difference</td>
<td></td>
</tr>
<tr>
<td>Nevada</td>
<td>Examines data using criteria from AR, NM, &amp; PA</td>
<td></td>
</tr>
<tr>
<td>New Jersey</td>
<td>Discrepancy ≥ 6 percentage points</td>
<td>Applied if LEA enrolls at least 100 white males and 100 African American males</td>
</tr>
<tr>
<td>New Mexico</td>
<td>Equity Index (see description in text)</td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>Chi-square test of significant difference</td>
<td></td>
</tr>
<tr>
<td>North Carolina</td>
<td>Discrepancy ≥ 10 percentage points</td>
<td>Applied if &gt; 19 African American students receiving special education</td>
</tr>
<tr>
<td>North Dakota</td>
<td>Odds ratio ≠ 1.00</td>
<td>Criterion used as a preliminary benchmark to track future data</td>
</tr>
<tr>
<td>Oregon</td>
<td>Chi-square test of significant difference</td>
<td>p &gt; .001</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>Discrepancy ≥ 5 percentage points &amp; z-score</td>
<td>p &gt; .10</td>
</tr>
<tr>
<td>South Dakota</td>
<td>Z-score</td>
<td>p &gt; .05</td>
</tr>
<tr>
<td>Tennessee</td>
<td>Discrepancy ≥ 20 percentage points</td>
<td>Odds ratio used if non-white student or odds ratio</td>
</tr>
<tr>
<td></td>
<td>or odds ratio</td>
<td>population in LEA &lt; 20%</td>
</tr>
<tr>
<td>Texas</td>
<td>Chi-square test of significant difference</td>
<td>p &gt; .05</td>
</tr>
<tr>
<td>Virginia</td>
<td>&gt; 20% variation from expected raw number</td>
<td></td>
</tr>
<tr>
<td>West Virginia</td>
<td>Double the percentage of students in a racial/ethnic Group found in the LEAs total enrollment</td>
<td>Criterion applied only if the cell size is 10 or greater and signifies only disproportionately high representation</td>
</tr>
<tr>
<td>Wyoming</td>
<td>Confidence interval based on binomial distribution</td>
<td></td>
</tr>
</tbody>
</table>

Ten states have chosen a percentage-point discrepancy, with the other four using a discrepancy criterion based on percentages. The calculation of each compares the percentages of the racial/ethnic group in the student population with the disability grouping. Nevertheless, the method of determination of disproportionality is the basic difference between the two groups. Developing their unique definition of disproportionality, states were determined to stay in line with the Biennial Guidelines, developing definitions unique to their populations. This procedure was further demonstrated by states using statistical-significance tests, odds ratios, and other criteria (See Table 1).

**Statistical-Significance Tests and Odds Ratios**

Fourteen states applied a variation of statistical tests and odds ratios to determine disproportionality. The statistical tests determined if the actual number from a racial/ethnic group differed from the percentage of that racial/ethnic group in the total population more than would be expected by chance. Five states, Maryland, Missouri, New York, Oregon, and Texas used a chi-square test. While Nevada, Pennsylvania, and South Dakota used z scores, Colorado used a t-test. Wyoming used a confidence interval that took into consideration the size of the particular population in question, creating a confidence interval that provided acceptable ranges of incidence. A large sample size would provide a narrow-confidence band, while a small population would provide a wider-confidence band. Three other states, Alabama, North Dakota, and Tennessee, calculated an odds ratio; moreover, Alabama and North Dakota used a value of 1.0 as a benchmark for evaluating disproportionality. Additionally, North Dakota used a comparison to rates of identification for students who were White in order to provide a consistent benchmark. The formula used was:

\[
\frac{\text{# Students in racial/ethnic group with a given disability}}{\text{# Students in racial/ethnic group in total student population}} \quad \text{and} \quad \frac{\text{# White, non-Hispanic students with a given disability}}{\text{# White, non-Hispanic students in the total student population}}
\]
Like the first fourteen states, the above states focused on the percentage of the racial/ethnic group in their varying populations. The major difference here was the use of a statistical test that determined whether the actual number from a racial/ethnic group differed from the percentage of that racial/ethnic group in the total population more than would be expected by chance. Furthermore, a baseline comparison was made to the proportionality of White, non-Hispanic students. Latitude given to the states again is evident in the unique development of the definition (See Table 1).

**Other Criteria**

California, Minnesota, Mississippi, and New Mexico used various formulae in determining disproportionality. California examined the maximum percentage of enrollment for racial/ethnic group and percentage of racial/ethnic group in total school enrollment to total number of students in special education where $E = \text{maximum percentage of enrollment allowed for a racial/ethnic group}$, $A = \text{percentage of racial/ethnic group in total school enrollment}$, and $N = \text{total number of students in special education}$. $E = A + \sqrt{[(100 - A) N] / N}$ is the California formula. Minnesota calculated its disproportionality by observing any value greater than zero as an indicator of disproportionality, using another formula. This included $S = \text{percentage of special education students in that racial/ethnic group}$ and $N = \text{percentage of total student enrollment in that racial/ethnic group}$ where $\text{Disproportion} = (S - N) / N$. Mississippi calculated disproportionality by examining the actual enrollment of a racial/ethnic group to the group's total representation in the K-12 population. Disproportionality was evident when the difference was two or more standard deviations. Where $T = \text{total number of students in a program or disability category}$ and $P = \text{proportion of the racial/ethnic group in the total K-12 enrollment}$, $\sqrt{\frac{T^* P^* (1-P)}{}}$. Finally, New Mexico calculated an Equity Index by dividing the percentage of students with disabilities in a given racial/ethnic group by the percentage of all students in that racial/ethnic group. A quotient of 1.5 or greater indicated a significant disproportionality.
It is evident that states used a variety of methods to determine their definitions of disproportionality. The focus was on the percentage of racial/ethnic group in the various populations (i.e., overall student population and group population). There was an exception noted where North Dakota used a comparison to rates of identification for students who were White in order to provide a consistent benchmark. Attempting to define disproportionality, the states continue to look within their own schools for an answer.

The appropriate approach to determining disproportionality in special education appears to be as elusive as the guidance from OCR. Despite little guidance from OCR, states continue to develop their unique definitions of disproportionality. There do not appear to be any trends regarding the use of criteria. The variability of criteria is evident in that methodology ranges from percentage-point discrepancy to a calculated-equity index. The trend that continues is the individuality of states defining disproportionality based upon their own unique variables. In examining the risk ratios in the Educable Mentally Disabled (EMD) and Emotional Disabled (ED) categories for the states, there is no noticeable trend regarding percentage-point discrepancy or equation choice. Moreover, examining geographical location, proximity, or minority population fails to yield any clues as to why states choose the methodology they do.

**IMPLICATIONS FOR FUTURE RESEARCH**

Although the focus of this paper was to examine the legal development of disproportionality, there are a number of issues that have evolved in this process. It is obvious from the examination of the historical process of defining disproportionality that remedies for this process are going to be varied and dynamic. There is the assumption that a clear and unambiguous definition of disproportionality will facilitate a reduction in overrepresentation. History gives us little guidance, as the ways of dealing with the problem of disproportionality, although evident for decades, have not led to effective change. Remedies that work for one state may not work for another. The focus of future research may need to be on why states chose their definition of disproportionality. Once the rationales are examined,
commonalities of methodology may become evident and possibly could lead to the development of a standard approach to defining disproportionality. Such a development may facilitate a greater ease of monitoring due to a more standardized criterion. There are a number of concerns of which we need to be aware until we are able to realize a common approach. One such concern is that states should make a concerted effort to examine all categories of disabilities, so as not to shuffle students from one disability category to another.

In summary, overrepresentation remains a long-standing problem in special education. Burnette (1998) states that it is a complex problem, calling for an array of strategies. Office of Special Education Programs (OSEP) and OCR continue to address disproportionate representation as a priority. OSEP funds research and technical-assistance activities that provide insight into the issues and strategies to resolve overrepresentation issues. Yet, a clear understanding of the process of defining disproportionality may be necessary before the issue can be adequately addressed.

Several issues must be investigated regarding the process of defining disproportionality. Based upon their unique variables, each state is attempting to define disproportionality. Nonetheless, considering the process or motivation behind the development of each state’s definition is important not only to understanding the nature of disproportionality but also to the commitment of each state to address issues of segregation. The sincerity of this commitment may determine the extent to which new definitions facilitate change. The following questions must be addressed if the process of developing definitions of disproportionality is going to have the intended effect: (a) Will the states’ definition of disproportionality lead to procedures that remedy segregative aspects of special education programs? (b) Will OCR be able to monitor and interpret the various definitions of disproportionality?
REFERENCES


Federal Register, 1999, Vol. 64, No. 48, P. 12651-12652.


Johnson v. San Francisco Unified School District, 500 F.2d 349 (9th Cir. 1974).


PART 5: COLLEGE OF ENGINEERING AND INFORMATION TECHNOLOGY
SCIENCE YOU CAN UNDERSTAND: NUCLEAR TECHNOLOGY (FISSION, RADIATION, POWER PLANTS, AND WEAPONS)

D. Samuel Deutsch

Department of Chemical Engineering
College of Engineering and Information Technology

Science You Can Understand is a series of papers meant to demystify some aspects of chemical engineering and science in general. Its purpose is to answer some basic questions about current products, systems, and processes that are at the forefront of our technological society. This is the second paper of the series, and focuses on nuclear radiation, nuclear power, and nuclear weapons.

ATOMS: REVISITED

The first paper of the series was meant to demystify the concept of the astronomically small constituents of matter known as atoms. Since “nuclear” implies the nucleus of an atom, it is necessary to brush up on this subject, as well as complicate the matter further with one of the key players of nuclear radiation: the neutron.

Everything is made of atoms, which bind together to form molecules. A water molecule is made from the joining of two hydrogen atoms and one oxygen atom. In nature, any atom will be one of many elements (i.e., Gold, Copper, Helium, Radon, etc.). Everything on Earth (e.g., glass, clothes, beef, trees, computers, gasoline, air, coffee) is made up of combinations of the elements that are found in nature. The Periodic Table of Elements is a list of the elements found in nature in addition to a number of man-made elements.

Inside every atom are three subatomic particles: protons, neutrons and electrons. The nucleus of an atom is composed of protons and neutrons, which are bound together. The electrons surround and orbit the nucleus. Positively charged
protons and negatively charged electrons attract one another due to their respective equal and opposite forces. The Periodic Table of Elements lists each atom in its *non-ionic* form; the number of electrons and protons in a particular atom are equal, thus rendering the atom electrically neutral.¹

As opposed to protons and electrons, *neutrons* do not possess any charge. Their purpose in the nucleus is to bind protons together. Without neutrons, the positively charged protons would repel each other due to repulsive “like,” or similar, charges, resulting in the scattering of protons in order to reduce forces within the atom. In other words, the nucleus would not be stable and the atom would fall apart if neutrons were not present.

The number of protons in the nucleus is unique for each element. For example, if a nucleus contains 79 protons and 118 neutrons, and there are 79 electrons surrounding that nucleus, it must be an atom of gold. Millions of gold atoms grouped together are used to make gold bars, jewelry, and even gold foil. All gold found in nature is called gold-197. The “197” is the atomic weight, or the sum of the number of neutrons and protons in the nucleus. An atom of gold-197 will not change over millions of years. Therefore, it is called a stable atom; however, not all atoms act in this manner.

**ISOTOPES AND RADIOACTIVE DECAY**

Many elements come in different forms. For example, iron has four stable forms: iron-56 (making up about 92% of all natural iron), iron-54 (6%), iron-57 (2%), and iron-58 (less than 1%). The 4 forms are called *isotopes*. Isotopes are atoms that have equal numbers of protons and electrons but have differing numbers of neutrons. For example, all types of iron isotopes have 26 protons and 26 electrons, but iron-56 has 30 protons, while iron-57 has 31 protons. Both isotopes are iron atoms, they act and look the same, and they are both stable.²

Some elements have isotopes that are *radioactive*. Hydrogen is a good example of an element with multiple isotopes, one of which is radioactive. Normal hydrogen, or hydrogen-1, has one proton and no neutrons (there’s no need to bind protons). There is another isotope, hydrogen-2, or deuterium, which has
one proton and one neutron. Deuterium is not commonly found in nature (less than 1% is found naturally). Although it can react and form water like hydrogen-1, it can be toxic in high concentrations. Deuterium is a stable isotope of hydrogen. Hydrogen-3, or tritium, has one proton and two neutrons. This hydrogen isotope is unstable. A container full of tritium will change into helium-3 (two protons, one neutron), a stable atom, if left for a long period of time. This process is called radioactive decay. Perhaps the two most well known elements that undergo radioactive decay are uranium and plutonium.

Radioactive decay is a natural process. An atom of a radioactive isotope will spontaneously decay into another element through alpha decay, beta decay, or spontaneous fission. Four different kinds of radioactive rays are produced during the decay process: alpha rays, beta rays, neutron rays, and gamma rays.

Americium-241 is an artificially created radioactive element. It is most commonly used in smoke detectors due to its proneness to alpha decay. An americium-241 atom will spontaneously throw off an alpha particle. An alpha particle is composed of two protons and two neutrons, the equivalent of a helium-4 nucleus. In the process of emitting the alpha particle, the americium-241 atom changes to a neptunium-237 atom. The element changes because the number of protons and electrons in the atom changes. Furthermore, the neptunium atom will exhibit its own chemical properties, which are not those of americium.

The rate of alpha particle emission is predictable if a large quantity of that substance is available to study. An atom’s half-life is the time it takes for half of a quantity of atoms to decay. For example, since it takes 0.8 seconds for half of the atoms in a seaborgium-263 cluster to change into rutherfordium-259, the half-life of seaborgium-263 is 0.8 seconds. Every radioactive isotope has a different half-life, ranging from fractions of a second to millions of years, depending on the species.

Tritium is an isotope of hydrogen that experiences beta decay. In this process, a neutron spontaneously changes into a proton, an electron, and another particle called an antineutrino. The new proton remains in the nucleus while the atom rejects the antineutrino. The ejected electron is called a beta particle. In all, the nucleus loses one neutron and gains one proton and one electron.
Therefore, an element that experiences beta decay will change into the element that has one more proton than the original element.

*Spontaneous fission* is the splitting of an atom, as opposed to the emission of an alpha or beta particle. The result of the spontaneous fission of an atom like plutonium-239 may be two atoms with considerably lower atomic numbers. During this process, the fissionable atom will release neutrons that can be absorbed by other atoms and cause nuclear reactions (decay or even more fission reactions). The neutrons can even collide with other atoms and create high-energy light waves called gamma rays.⁴

A non-radioactive substance may become radioactive if it is bombarded by neutrons. This is called *neutron radiation*. This type of radiation is found in nuclear reactors on land or on ships, as well as in particle accelerators.⁴

A nucleus that has experienced radioactive decay will be highly energetic and, thus, unstable. The new atom may eliminate its extra energy as a gamma ray. Gamma rays are similar to X-rays. Both types of emissions are dangerous; however, *gamma rays* are of much greater energy than X-rays. Therefore, gamma rays can do significantly more damage to living things than X-rays. Unlike alpha or beta particles, gamma rays are not matter; gamma rays (and X-rays) are high-energy beams of light.⁴

Alpha particles, beta particles, neutrons, and gamma rays are all known as *ionizing radiation*, and they are dangerous to all living things. When these rays interact with an atom they remove electrons. This phenomenon has been known to cause serious health problems such as cell death, genetic mutations, reproductive disorders, and cancer.⁴⁵

The strength of ionizing radiation varies with the type of radiation. Alpha particles are large and they cannot penetrate very far into matter. In fact, they cannot penetrate a sheet of paper. They have no effect on people when outside the body. However, if you ingest atoms that emit alpha particles, they can cause severe damage to the delicate tissue that is exposed. Beta particles penetrate more deeply, but again, they are harmful only if ingested. Aluminum foil can be used to shield oneself from the emission of beta particles. The only common material used to
impede gamma rays is lead. Neutrons penetrate very deeply due to their neutrality (positive and negative charges from incident atoms have no effect on charge-free neutrons). Thus, neutrons are best stopped by extremely dense materials, such as liquids (water or heavy oils) or thick layers of concrete. Due to their levels of penetration, gamma rays and free neutrons are the most dangerous types of nuclear radiation.5

NUCLEAR POWER

Uranium-235 is one of the few materials that can undergo induced fission. If a free neutron runs into a U-235 nucleus, the nucleus will absorb the neutron without hesitation, become unstable and immediately split into two lighter atoms in addition to throwing off two or three neutrons. The two new atoms then emit gamma radiation as they settle into their new states.

The probability of a U-235 atom capturing a neutron as it passes by is high. In a reactor that is working properly, one neutron ejected from each fission causes another fission to occur. This is known as a chain reaction. Also, the splitting of the bombarded atom happens on the order of a pico-second (0.000000000001 seconds).3

Most importantly, when a U-235 atom splits, an incredible amount of energy is released in the form of heat and gamma radiation. In addition, the two atoms that result from the fission release beta and gamma radiation of their own. The sum of the masses of the two atoms produced from the fission does not equal the original mass of the U-235 atom. Conservation of mass dictates that the difference in weight is converted directly to energy at a rate governed by the equation \( E = mc^2 \), where “m” is the mass of the emitted particles, “c” is the velocity of the particles, and “E” is the resulting energy. A pound of U-235 (a 4 inch cube of approximately 12.x1024 atoms) has the energy equivalent of around a million gallons of gasoline. One can see why nuclear technology is employed in the military. Naval vessels can produce large quantities of energy in small spaces. Plus, nuclear bombs have the potential to eliminate enormous quantities of land and life, all with only 8 pounds of fissionable material.
In order for a chain reaction in nuclear power plants to occur, the uranium must be enriched to the point where it contains 3% or more uranium-235. For weapons-grade uranium, the fissionable material must be at least 90% U-235.3

NUCLEAR POWER PLANTS

A nuclear reactor requires mildly enriched uranium or plutonium in the shape of rods for its fuel. These rods are bundled together and then submerged in a coolant, typically water, inside a pressurized vessel. In order for the reactor to work, the uranium bundle must be reactive enough, that, if left without coolant, the uranium would eventually overheat and melt.

In order to prevent meltdown, materials that absorb neutrons are formed into what are called control rods and are raised or lowered into the bundles according to the desired reactor temperature. If a higher temperature is desired, the control rods are raised out of the bundle and the uranium is free to undergo the neutron chain reaction. When the temperature is too high, the control rods are lowered into the bundle and inhibit the chain reaction by absorbing the emitted neutrons. To completely stop the reaction (in the event of an accident or repairs), the control rods are lowered to the very bottom of the reactor (throughout the entire length of the bundle) and there are no free neutrons to carry out the reaction.3,5,6

Inside the reactor, the uranium generates large quantities of heat that converts much of the liquid water to steam. The vapor drives a steam turbine, which spins a generator to produce electrical power. Many reactors have incorporated a heat exchanger into the system. In this case, the fuel heats the coolant, and the hot coolant transfers its heat via the heat exchanger to a secondary fluid. The secondary fluid then drives the turbine. There are many advantages to this system. One is that the fluid in contact with the turbine is never in contact with the radioactive material. This reduces the risk of equipment contamination by radioactive material. Another advantage of using two fluids is that the liquid in contact with the fuel does not need to be water. Liquid metal such as sodium also can be used to cool the bundles and transfer energy through the heat exchanger. Liquid metal can
achieve much higher temperatures than water, thus the heat is transferred more efficiently. Also, if only heat (and not radioactivity) is transferred across the heat exchanger, the water used as the secondary fluid can be returned to lakes or rivers without any radioactive materials to pollute the water. On the other hand, thermal pollution in these bodies of water (changing the average temperatures of lakes or rivers) still poses a very serious problem.\(^6\)

The reactor's pressure vessel is typically housed inside a concrete liner that acts as a radiation shield. That liner is housed within a much larger steel containment vessel. This vessel contains the reactor core as well the hardware that allows workers at the plant to refuel and maintain the reactor. The steel containment vessel is intended to prevent leakage of any radioactive gases or fluids from the plant. Finally, the containment vessel is protected by an outer concrete building that is strong enough to survive such things as crashing jet airliners. These secondary containment structures are necessary to prevent the escape of radiation/radioactive steam in the event of an accident such as that at the United States nuclear plant at Three Mile Island. The absence of secondary containment structures in Russian nuclear power plants allowed radioactive material to escape in an accident at Chernobyl.\(^7\)

**NUCLEAR BOMBS**

As one can easily see from the previous sections, there is no real difference between the fuel in a nuclear reactor and a nuclear bomb; it only depends on the percentage of the U-235 isotope in the uranium. The three components to an atomic bomb are a source of fissionable material, a detonation device, and way to allow the fissionable material to react before the explosion occurs.\(^8\)

There are two types of atomic bombs: fission and fusion bombs. A fission bomb operates on the emission of energy upon splitting of an atom, whereas a fusion bomb relies on the collision of two atoms to produce energy. This paper will focus only on fission bombs.

A fission bomb uses an element like uranium-235 to create a nuclear explosion and is based upon the principles of induced-nuclear fission. The fuel must be
kept in separate subcritical masses. A subcritical mass is an amount of fissionable material so small that it will not react with itself. This ensures the prevention of premature detonation. By definition, critical mass is the minimum mass of fissionable material required to sustain a nuclear fission reaction. The separation of the subcritical masses is the most complex aspect of developing a nuclear bomb. Two or more subcritical masses must combine to form a supercritical mass that will provide more than enough neutrons to sustain a fission reaction at the time of detonation.

Neutrons are introduced by making a neutron generator from a small pellet of polonium and beryllium, separated by foil within the fissionable fuel core. When the subcritical masses meet, the foil is broken and the polonium rapidly emits alpha particles, which collide with isotopic beryllium to produce free neutrons. The neutrons then initiate fission. The fission reaction is confined within a dense material called a tamper. The tamper gets heated and expands due to the pressure exerted by the fission core. This expansion of the tamper exerts pressure back on the fission core and slows the core's expansion. The tamper also reflects neutrons back into the fission core, increasing the efficiency of the fission reaction.

There are two main techniques for joining the two subcritical uranium masses that start a nuclear reaction in a fission bomb. The first is called gun-triggered fission. This type of initiator uses a gun to fire a bullet of uranium-235 into a sphere of the same material. The neutron generator is located inside the U-235 sphere and upon collision of the sphere with the bullet, neutrons are generated and the fission begins. The firing of the U-235 bullet is not arbitrary. The gun is fitted with a barometric-pressure sensor that determines the appropriate altitude for detonation. This was the type of bomb dropped on Hiroshima in the Second World War. It had a 1.5% efficiency, which means that only 1.5% of the fissionable material reacted before the explosion carried the rest of it away.
Figure 1: "Little Boy" was the name the gun-triggered fission bomb dropped on Hiroshima, Japan. The gun fired the U-235 bullet through a barrel along the axis of the bomb. (Photograph courtesy of Rice University and the National Archives)

The second type of fission bomb is triggered by implosion. Scientists working on the Manhattan Project recognized that using standard explosives to create a shock wave would be a suitable way to join the subcritical masses of uranium. The bomb was made of a spherical U-235 tamper and a plutonium-239 core that was surrounded by explosives. Upon detonation, the explosives fired which created a shock wave. The compression from the wave compressed the core which initiated the fission chain reaction. This was the type of bomb that was dropped on Nagasaki; it had an efficiency of 17%. This type of bomb exploded very quickly. The fission occurred in approximately half a millionth of a second.

As a final note on this subject, it is hard to believe that only a few handfuls of chemicals could produce the devastation that occurred on August 6th and 9th, 1945. The atrocities caused by these weapons were so great that humankind has bonded together to try and put an end to the use of such weapons of mass destruction.
DIRTY BOMBS

With the spread of terrorism, unconventional weapons have become a threat to many people’s way of life. Instead of military targets, unconventional weapons are frequently aimed toward civilian populations. An unconventional weapon that has received much attention following the arrest of the terrorist, Abdullah Al Muhajir, is the dirty bomb.

Instead of using nuclear fission to create thousands of megatons of explosive power, dirty bombs use only conventional explosives to create a relatively small blast. However, the blast from a dirty bomb is not only meant to cause harm; its purpose is to distribute radioactive material over large distances in order to cause chaos. This radioactive material can be in the form of powder, granules, or pellets.

The biggest difficulty in constructing a dirty bomb is the acquisition of nuclear materials. Sources of which (now being very highly guarded) are nuclear power plants and nuclear waste disposal sites. Once the nuclear material has been
obtained, it must be formed into dispersible shapes, and then mixed with a conventional explosive such as TNT, or trinitrotoluene.

A dirty bomb has never been used against any population; however, the United Nations reports that in 1987, Iraq tested a radiological dispersion device with limited success.¹ The explosives created a blast that was comparable to traditional materials. Although it was successful in distributing bits of nuclear material, the particles were not very radioactive. In fact, the resulting radiation levels were too low to cause any significant damage to humans. Thus, dirty bombs really cause more confusion and fear rather than any real physical damage beyond that of the detonation of a traditional explosive.

POSTSCRIPT: WHY SCIENCE YOU CAN UNDERSTAND?

This series of papers is meant to educate people about the methods and systems of modern technology. Society relies on science and engineering every day, and the majority of people who use products like automobiles, computers, mobile phones, and airplanes are ignorant about the fundamental concepts that make these amenities work.

Neither Rome nor the fundamental theorem of calculus was constructed in a day. The great physicist Isaac Newton transformed the understanding of the forces that govern the universe; his laws of motion stand today. Late in his life he was asked how he was able to accomplish such great things. He replied: “I stood on the shoulders of giants.” If this statement is true, then we all rely on the discoveries made by thousands upon thousands of scientists. Science You Can Understand is a way for non-technical people to behold what has been given to them. It is truly a wonderful thing to understand, learn from, and build upon these innovations in order to make discoveries in our own time.
REFERENCE NOTES


THE AAPP EXPERIENCE:
A PERSONAL EPILOGUE

Sirena C. Hargrove-Leak
Department of Chemical Engineering
College Of Engineering and Information Technology

I have had the pleasure of being one of the first scholars selected for the African American Professors Program (AAPP) since its implementation in the fall semester of 1998 by Dr. Aretha B. Pigford. Since then we have had two new directors, Dr. Leonard O. Pellicer, and our current director, Dr. John McFadden. The Program has six distinguished alumni who have proceeded to do some great things, and several new scholars have enrolled in recent years. However, a few aspects of the program have not changed: AAPP continues to strive to diversify the nation's university-lecture halls starting at the front; the University of South Carolina continues to endorse this mission by supporting the components and activities of AAPP. AAPP scholars' lives are continually enriched by the experience of being involved with excellent mentors in meaningful ways. The purpose of this Epilogue is to encourage readers to join me in exploring some of the ways that the scholars have benefited from AAPP participation.

AAPP is a unique program among very few efforts to encourage African Americans to pursue doctoral degrees and careers in higher education. Another notable program is located at Georgia Institute of Technology (Georgia Tech) and is known as Facilitating Academic Careers in Engineering and Science (FACES) (University System of Georgia's Programs of Excellence Subcommittee, 2001). It is a collaborative effort with Morehouse College designed to increase the number of African Americans receiving doctoral degrees in engineering and sciences in which participants are encouraged to pursue careers as faculty members. In addition to FACES, numerous programs that encourage African American males to pursue goals of higher education were located by a special subcommittee of a University of Georgia System task force. Among them was a program at Georgia Tech that has
encouraged more than 300 Black males over 10 years to pursue graduate degrees in science, engineering, and mathematics. Although many programs exist to encourage African Americans to pursue graduate education, AAPP appears to be unique in that it provides a complete support system for African Americans who are working toward doctoral degrees in a variety of disciplines. The program also was designed specifically to assist participating African American students in preparing for success in their future careers as faculty members.

It has been said that one of the reasons that there are so few African Americans with academic careers is that they are not properly equipped with some essential skills to be successful prior to accepting academic positions. AAPP has continued to address these issues through its professional-development component. Monthly seminars covering topics such as mock interviewing, elements of an academic-job search, grant-proposal writing, effective teaching, scholarly publishing, and panel discussions with assistant professors at or near the start of their careers have continued to provide the AAPP scholars with valuable insights about what is required to obtain a position and to navigate within the academic world. I have departed from each such seminar with at least one suggestion, word of advice, or resource that has made me feel more prepared to face the challenges of an academic career. Furthermore, the added preparation has made me feel more confident in my ability to succeed, and that alone can take me and the other scholars quite far in our career pursuits.

In my contribution to this monograph series last year (Hargrove, 2002), I focused on the difficulties experienced as a Black female navigating through a doctoral program in chemical engineering, in which I was the first and only Black female who had pursued that degree. It is clear that science and engineering faculties include few women (Turner & Myers, 200) and, perhaps, fewer African Americans. For instance, National Science Foundation records indicate that only 2.7% of science and engineering faculty members in 1995 were African Americans; yet, the number of doctorates earned by Black science and engineering students was 3.4% in 1997 (May, 2002). It seems that many special programs for minorities in science and engineering, such as those highlighted by the
University System of Georgia's Programs of Excellence Subcommittee (2001), are focused on males. However, in higher education literature, concerns about the hiring, salaries, and promotion of females in college and university faculty positions are longstanding (Nettles, Perna, & Braeburn, 2002); in science, mathematics, and engineering the lack of diversity is even more clear (Turner & Meyers, 2000). My experience certainly indicates the complexity of such matters for African American women who pursue faculty positions in these disciplines. It seems evident that a program such as AAPP would be merited in many institutions throughout the country and that such programs could address many of the issues specific to the success of minority women as well as to the men who choose academic careers.

One of the strongest aspects of AAPP is that it is an excellent conduit for networking. Over the years, the scholars have had numerous opportunities to meet university, local, and state leaders when they have conducted the aforementioned professional seminars and attended formal social events. How many students at USC can say that they have had breakfast with the Provost? AAPP scholars can answer affirmatively, and they remember more than one of these occasions! How many people have had the honor of spending an hour with five state senators and representatives and a leading television-news anchor, discussing ways to become society leaders and to respond appropriately to community needs? Again, several of the current AAPP scholars have had that distinct honor. The relationships that were established during those meetings were quite significant. None of these individuals would have taken the time out of their busy schedules to spend time with the scholars if they did not believe in the mission of AAPP and were not committed to assist us in succeeding. Therefore, each such meeting has ended with the distinguished person extending a helping hand to us if and when we should ever need it. Certainly, each of us is capable of meeting people and developing similar relationships, but AAPP brings the distinguished leaders to us.

The AAPP also recognizes that professional success is worthless without personal development to promote health, wellness, and fiscal well-being. Therefore, each series of the professional-development workshops always includes at least
one session covering topics related to personal growth. Since I have been a scholar, some of the key topics that have been covered are physical fitness, holistic health and meditation, and financial planning. These have been particularly helpful for me for two reasons. Initially, I had been exercising regularly prior to coming to the University of South Carolina; however, when I arrived at the university, my academic program was so rigorous from the beginning that I failed to reserve time to seek opportunities to continue my personal physical-fitness program. The holistic-health workshop was a great introduction to available facilities at USC. Secondly, the workshops not only provided valuable information, but they also offered a frequently needed break from the normal-work routine. On seminar days AAPP scholars generally are able to discover benefits from the workshops immediately.

I would be remiss to exclude some discussion of the financial benefits of being an AAPP scholar. Of course, funds for the stipend, tuition, and cost of books provide much needed financial assistance; however, the financial benefits for AAPP scholars are quite comprehensive. AAPP provides funds for travel, research support, and for professional association memberships. I often have taken those things for granted because, with the exception of the professional association memberships, this extensive support was always a part of the financial award for engineering-students' financial packages. Now, I understand that all disciplines are not as fortunate, and I appreciate the true value of such a benefit. It gives many students an opportunity to attend conferences in order to present their work and to join important professional organizations. Again, having this kind of support is of great value for professional development and networking.

Mentoring also is a vital component of AAPP; it is both formal and informal based on the experiences shared by the scholars over the years. The strongest predictor with competing on the “fast lane” of a science-research career is recognition by an influential mentor (Arnold, 1993). In many cases, male faculty are filling the mentoring role for AAPP scholars. In the case of female doctoral students, it can be difficult to address concerns regarding female issues with male mentors; therefore, informal mentoring relationships with both female and Black
faculty members is quite desirable. Apparently, a lack of appropriate female mentors is one barrier to the success of some female academics (Reinlie, 2002); hopefully, seeking informal-mentoring relationships as a doctoral student will be a process that will follow AAPP females throughout their careers. Typically, female faculty do not advance as quickly as males in academe (Hall & Sandler, 1986); however, females are likely to encounter quite complex career conflicts. For example, "[t]he literature on scientists and their work, along with research on the career development of professional women...indicates that a potential mismatch exists between the single-minded devotion to science...and the desire to balance family and a career that appears so prevalently in reports of professional women" (Subotnik & Arnold, 1996, p. 267). Through networking AAPP scholars have been able to receive mentoring informally from several mentors as they progress through their academic programs; thus, a complexity of individual issues can be addressed as a result of AAPP networking processes.

Finally, AAPP has provided something that some would argue is even greater than all of the previously mentioned items: An opportunity to develop friendships with other African American students with similar goals and experiences. This was, indeed, an invaluable resource for me, and I attribute much of my ability to survive at USC to having the opportunity to develop these relationships. When I began graduate study, I was the only African American student in my program in the College of Engineering. As a graduate of a historically Black college, this was quite an adjustment for me. Further, race aside, most of my colleagues in my department did not welcome me into their study groups or social circles in those early days, and those who did welcome me were so different from me that I simply did not enjoy the experience or obtain anything of true value from it (Hargrove, 2002). Needless to say, I often felt very alone. Not only were some of my first friendships at USC formed within AAPP, but AAPP also became my source of cultural grounding. The other scholars knew of my struggles to survive in this new environment and were supportive every step of the way. They boosted my self-confidence, which we've known for over a decade is a better predictor of adult achievement than high grades or high aspirations (Eccles, 1985). Thanks to the
support of AAPP scholars I found strength when I was ready to give up, encour­
agement when my self-esteem was depleted, and joy when the stress of it all
engulfed me in gloom.

As you can see, the African American Professors Program is not just a fellow­
ship; it is an experience that extends from professional to personal development.
As I prepare to graduate from the University of South Carolina, I pray that in the
midst of USC’s constant change and growth that the AAPP legacy will live for many
years to come. I am forever indebted to AAPP for all that it has done for me, and
I look forward to doing my part to continue the legacy by fulfilling the mission of
AAPP by diversifying at least one of the nation’s chemical-engineering classrooms.

R E F E R E N C E S

Hulbert & D.T. Schuster (Eds.), Women’s lives through time: Educated American women of the

terns. In F D. Horowitz & M O’Brien (Eds.), The gifted and talented: Developmental perspectives

Hall, R. M., & Sandler, B. R. (1986). Academic mentoring for women students and faculty: A
new look at an old way to get ahead (ERIC Document Reproduction Service No. ED240891).

ing doctoral program. In J. McFadden (Ed.), African American professors program monograph
(175-183). Columbia, SC: University of South Carolina.

Presentation at the Conference of Black Graduate Engineering and Science Students (BGESS),
http://www.me.berkeley.edu/lagens/documents/bgess022.pdf.

Nettles, M. T., Perna, L.W., & Braeburn, E. M. (2000). Salary, promotion, and tenure status of
minority women faculty in U.S. colleges and universities. Education Statistics Quarterly. Retrieved


women in science. In K. D. Arnold, R. F Subotnik, & Noble, K. D., Remarkable women (pp. 263-
280). Hampton Press.

PART 6: COLLEGE OF PHARMACY
STROKE: A REVIEW OF THE DISEASE STATE

Phyllis I. Perkins, Pharm.D.

Department of Pharmaceutical Health Outcomes Sciences
College of Pharmacy

Stroke is a very serious disease affecting millions of people every year in the United States. The severity of its effects ranges from leaving people disabled, both physically and/or mentally, to death. The southern states, commonly referred to as the “stroke belt,” have the highest rate of stroke nationally. More people in this region suffer fatal strokes than in the rest of the United States. As an African American, it is important to inform others of the devastation that can be prevented if we are initiated early. African Americans have a higher rate of stroke than Whites and a higher mortality as well. Stroke can be prevented and is sometimes treatable, but it starts with education. This monograph serves as an educational tool to aid its readers in recognizing stroke signs and learning about pharmacologic treatments available. The focus is on “ischemic” stroke, which accounts for approximately 85% of strokes. Even with all the advances that have been made, preventive measures are stressed, especially control of blood pressure, which is one of the most modifiable risk factors of all.

EPIDEMIOLOGY AND ETIOLOGY

Stroke, also known as a brain attack, is a major manifestation of cerebrovascular disease. Stroke refers to the sudden onset of a focal neurological deficit whereas cerebrovascular disease refers to any type of pathophysiologic disease of the brain. When strokes occur, the neurologic manifestations that occur are the result of the location of injury in the brain, the extent of the “ischemia” (obstruction of the blood supply), “infarct” (dead tissue), or “hemorrhage” (bleeding). A stroke may show varied manifestations, reversible and irreversible, ranging from “hemiplegia” (i.e., paralysis of one side of the body) to sensory deficits. Although mortality has declined over the years, unfortunately stroke is still the third leading cause of death in the United States.
In 1972, the American Heart Association (AHA) issued a special statement on risk factors for stroke. At that time, major risk factors for ischemic stroke were identified as transient-ischemic attacks (TIAs), cerebral infarction, hypertension, cardiac abnormalities, and other consequences of “atherosclerosis” (hardening of the arteries) and diabetes mellitus. Since 1971, mortality from stroke has continued to decline although the reasons are not clear. Evidence suggests that the decline in mortality may be related to more effective treatment of hypertension and positive lifestyle changes.

“Atherothrombotic infarction,” caused by the presence of a blood clot, is the most common type of stroke, representing almost 65% of the reported cases of the 85% caused by ischemia shown by general population studies. The majority of strokes are caused by ischemia and infarction, secondary to disease of the arteries that supply blood to the brain. Cerebral embolism accounts for 20% of all strokes. Hemorrhage into the brain tissue and “subarachnoid hemorrhages” (bleeding between the brain and the middle lining) account for approximately 15% of all strokes. The AHA estimated in 1995 that 1 of every 15 deaths is a result of stroke and that 4 million people survived a stroke. It is estimated that 600,000 people annually will suffer a new stroke or a recurrent stroke.

A major impact of stroke is the resultant disability in approximately half of all patients hospitalized for cerebrovascular disease. The overall direct and indirect economic impact is estimated to exceed $43 billion annually and is expected to rise over time. Because of the devastation stroke can cause, prevention is of primary importance, and proper prevention requires correction of modifiable risk factors in persons at highest risk.

**RISK FACTORS IN ISCHEMIC STROKE**

In regards to single-risk factors, age, gender, race, ethnicity, and heredity cannot be modified. Stroke increases with age, and stroke rates double after reaching 55 years of age. Most stroke victims are 65 and older. More men than women have strokes. For minorities, there is higher mortality for African Americans, Asian Pacific Islanders, and Latinos than for Whites. Some of these ethnic and racial differences may result from increased evidence of hypertension.
and environmental factors such as high-sodium diets. Diabetes mellitus is an independent contributor to "atherothrombotic-brain infarction" (stroke), and the risk is greater in women than in men. Individuals with a history of prior stroke have a high risk of recurrent stroke. Of all single-risk factors identified, hypertension, or high blood pressure, is the major predisposing factor for stroke and is strongly correlated to atherothrombotic-brain infarction as well as to cerebral hemorrhage. Hypertension is a factor in over 2/3 of all strokes. The Framingham study indicated that there is a direct relationship between elevation of blood pressure and stroke risk. Patients of all ages decrease their risk for stroke with greater control of blood pressure. Maintaining appropriate weight also affects blood pressure and glucose control in patients with diabetes.

Impaired cardiac function is the next most important single, treatable risk factor. All of the cardiac diseases listed above more than double a person's risk for stroke in comparison to those with normal cardiac function. Atrial fibrillation (AF) is strongly correlated with embolic stroke, and those patients with non-rheumatic atrial fibrillation have a six-fold increase in stroke frequency over those without AF.

Transient ischemic attacks (TIAs) are episodes of focal ischemic-neurologic deficit lasting 24 hours. The neurologic deficit depends on the thrombotic or embolic activity in the particular arterial supply to the brain. TIAs precede ischemic strokes in 60% of cases and 10% of all strokes, and 35% of patients untreated will develop a stroke within 5 years of a TIA. The greatest risk for stroke is early after a TIA with approximately 20% occurring within the first month, and 50% occurring within the first year. The more frequently TIAs occur, the higher the probability of stroke; a previous stroke is the greatest risk factor for subsequent stroke than a TIA alone. TIAs as risk factors also are influenced by other stroke-risk factors; therefore, treatment of other risk factors may influence the occurrence of stroke in patients with TIAs.

Elevated hematocrit (the proportion of blood occupied by cells) is another risk factor for stroke. Stroke in patients with this condition is attributed to decreased-collateral flow caused by increased blood viscosity. Sickle-cell patients
also are at increased risk of stroke. Stroke in middle-age men has been shown to correlate significantly with a maternal history of stroke. Increased lipid and cholesterol levels are risk factors for atherosclerosis, coronary heart disease and stroke. Lipoproteins play a primary role in early-stages of atherosclerosis, and lowering plasma cholesterol concentration decreases arterial-cholesterol accumulation.

Cigarette smoking is a major risk factor for both ischemic and hemorrhagic strokes. Causative factors may be increased platelet aggregability, increased fibrinogen concentration, decreased HDL-C, damage to the “vascular endothelium” (lining of the blood vessels), and increased hematocrit. Smokers are 2-3 times more likely to have a stroke than nonsmokers, and 4-6 times more likely to have a stroke in comparison to those who have never smoked. Smoking cessation has significant benefits in reducing stroke risk. Risk of stroke is higher for women smokers than for men smokers. The risk for all smokers decreases to that of nonsmokers within two to five years after cessation.

The association between oral contraceptives as an independent-risk factor and the incidence of stroke is dose dependent. Higher-dose formulations of oral contraceptives have been shown to increase stroke risk in certain subgroups of women such as those over the age of 35, hypertensives, those with hyperlipidemia, and those with histories of migraines. Newer products contain much lower doses of estrogen (i.e., less than 50 mcg) and progestin than the older medications. More recent studies have not shown an association between low-dose oral contraceptive use and stroke; nonetheless, caution is recommended in their use among women at high risk of stroke.

The Framingham study determined the following five stroke-risk factors:

- Elevated systolic blood pressure
- Elevated serum cholesterol
- Glucose intolerance
- Cigarette smoking
- Left ventricular hypertrophy
These factors, if present, can be used to identify the 10% of the population who will have 1/3 of all strokes in the United States. Various combinations of factors have been studied, and risk can vary greatly depending on the number of risk factors present. The most important single factor, once again, was found to be elevated blood pressure. Treatable single-risk factors should be vigorously addressed, and when multiple-risk factors are present, treatment should be initiated aggressively with particular emphasis on hypertension and positive life-style changes.

**PATHOPHYSIOLOGY OF ACUTE STROKE**

**Atherosclerotic Disease**

Atherosclerosis of brain arteries is a similar process to that found in extracranial vessels, those outside of the brain such as those leading to the heart. Atherosclerosis is caused by the buildup of excess cholesterol and fatty substances. Atherosclerosis and subsequent plaque formation result in arterial narrowing or occlusion, and that constitutes the most common cause of “aortacranial stenosis” (narrowing of the blood vessels). Plaque formation stimulates platelet aggregation. Atherosclerosis itself initially is seen as a fatty streak on the vascular wall that starts as a deposit of lipids in the “endothelial” (lining) cells of the vessel wall. This process may regress, remain stable, or it can progress. If it progresses, fibrous plaques are formed and lesions may form secondary to the interaction of a number of atherogenic substances, including LDL-C (commonly known as “bad cholesterol”) and others. Thrombosis may be more likely to occur in areas where plaque has narrowed the vessel. Formation of blood clots superimposed on these plaques may cause significant narrowing of the large extracranial arteries of the deep, penetrating intracerebral arteries. Other factors such as blood hypercoagulability, increased platelet counts, and increased hematocrit also may contribute to clotting and sludging of blood flow.

Embolism can produce a stroke when a clot, plaque, or platelet aggregate breaks off into the circulation and blocks the artery. When atherosclerotic plaque
ulcerates and pieces of it embolize distally, the emboli are called artery-to-artery emboli. Platelets play an important role in thrombosis, and loss of integrity of the endothelial surface of the arterial wall and resultant platelet activation can lead to formation of a “thrombus” (blood clot). This damage can result from trauma or from diseases such as atherosclerosis. When this occurs, vessel collagen can be exposed to the blood-triggering platelet aggregation. Aggregation is consolidated by coagulation factors, red and white blood cells, and formation of a fibrin network. This thrombus may continue to grow until the entire lumen of the vessel is blocked, or pieces of the thrombus may break off and embolize into more distal areas. The atherosclerotic process is variable, and the ischemic consequences resulting from this process depend on the adequacy of blood flow, collateral circulation, and embolism. These two factors determine the outcome of any ischemic event.

Cerebral Ischemia

Cerebral ischemia can be divided into focal and global (general) ischemia. Global ischemia is associated with lack of collateral-blood flow, and irreversible brain damage can occur within 4-8 minutes. In focal ischemia, some degree of collateral circulation remains, allowing for survival of brain cells and reversal of neuronal damage after periods of ischemia. Because of this potential for recovery, focal ischemia is considered treatable in some cases.

Transient Ischemic Attack

Transient Ischemic Attacks (TIAs) of cerebral origins are episodes of temporary focal-cerebral dysfunction of vascular origin in which the onset is rapid, of variable duration, and may last from seconds up to 24 hours. The most common duration is a few seconds up to ten minutes, depending on the location of injury. There may be no neurologic abnormalities between TIAs. The clinical manifestations are dependent on the territory of the artery involved and usually occur in the carotid system, the vertebrobasilar system, or both. TIAs are quite significant in that they herald an impending stroke.
The pathophysiology of TIAs involves the atherosclerotic process of thrombus formation in cerebrovascular arteries and low, cerebral-blood flow. Small microemboli in the form of platelet aggregates and cholesterol crystals break away from the thrombus and travel to distal areas where they lodge, producing ischemic attacks.14

**Cerebral Embolism**

Any region of the brain can be affected by embolism, but the middle-cerebral artery is affected most commonly. Embolism may result from fragments of an arterial thrombus that have broken away from a heart-valve vegetation. Other forms of embolism such as air, fat, or tumor cells occur only rarely. Cerebral embolism from “bacterial sepsis” (disease-causing bacteria in the blood) occurs frequently, but they are rarely large enough to produce a stroke.14 After breaking away, emboli usually circulate until they are too large to traverse the arterial lumen. Hemorrhagic transformation frequently occurs in the embolic process because of the reperfusion of blood into ischemic tissue, causing hemorrhage (i.e., usually in the middle-cerebral artery). Size of emboli varies; they may be so small that they produce no infarct or cannot be detected.14,15

Cerebral embolism secondary to thrombotic disease usually has a rapid onset, and it is not preceded by a TIA. This rapid onset is problematic because there is less time for collateral circulation to develop, resulting in great functional devastation. Cerebral embolism may result from heart disease; 20% of all ischemic strokes are caused by cardiogenic emboli.16

Chronic atrial fibrillation (AF) is the most common cause of cardiogenic emboli and is the most sustained dysrhythmia. AF increases with age (2-5% of those over 60 have AF), and more than half of AF-associated strokes occur in those over 75 years of age.17 Predictors of stroke risk in AF include history of hypertension, prior stroke or TIA, diabetes, and recent (within 3 months) heart failure.18 Patients who develop AF have high rate of embolus formation soon after the onset of AF, and recurrence is frequent. Changing heart rhythm from AF to normal-sinus rhythm increases the rate of embolus occurrence; approximately 2%
of patients may develop an embolus within the first few days of cardioversion. Anticoagulation therapy should be started at least 3 weeks before conversion and continued at least 4 weeks after conversion. The major causes of cardiogenic-cerebral embolism are:

- Nonvalvular atrial fibrillation 50%
- Coronary heart disease 20%
- Rheumatic heart disease 15%
- Prosthetic cardiac valves 10%
- Other 5%

PRESENTATION

Thrombosis in cerebral vessels produces variable-clinical manifestations. If the evolving thrombosis involves the internal-carotid and middle-cerebral arteries, then such focal symptoms as mono- or "hemiplegia" (paralysis of one side), mono- or "hemiparesthesia" (abnormal sensations), blindness in one eye, and speech disturbance may occur. If the vertebrobasilar system is involved, dizziness, "diplopia" (double vision), numbness, impaired vision, and "dysarthria" (speech and language disturbance) may occur. These attacks are usually short-lived and resolve in less than 10 minutes. The stroke itself most often develops suddenly as either a single attack or may be an intermittent or stuttering-progression pattern over hours to days. Some patients may suffer a partial stroke, improve for several hours, and later develop full paralysis of one or more parts of the body. Other areas become paralyzed in a stepwise manner until the stroke is completed. When the thrombosis produces a developing involvement over hours, days, or weeks, this is called stroke in evolution or progressing stroke.

DIAGNOSIS

Diagnosis consists of evaluation of the clinical presentation and laboratory findings. Laboratory evaluation can include tests such as cerebral arteriography, imaging studies such as CT (with or without contrast enhancement), MRI, radioactive brain-scan study (such as technetium scan), x-rays of the head, elec-
troencephalogram, ECG, transcranial-Doppler studies, digital-subtraction angiogram, and lumbar puncture. The definitive test for arterial occlusion or narrowing is the arteriogram. This process increases the risk for embolism in 2-12% of patients and should only be used if the diagnosis of vascular disease is unclear or if vascular surgery is a possibility. Because of these risks, brain imaging is the most important test after a stroke has occurred. When it is performed, transfemoral angiography is usually the procedure of choice. The CT scan in cerebral thrombosis is often normal in the first 48 hours after infarction. The CT scan is very useful in differentiating between intracranial hemorrhage and tumors, both of which dictate different treatment modalities. A CT scan may not show small-ischemic strokes; thus, a MRI may be needed. The MRI can detect small-ischemic strokes usually within the first hour of occurrence. An MRI is a noninvasive-imaging technique that does not require x-rays or isotopes like a CT scan. The MRI uses magnetic fields to generate images, and it takes longer to perform than a CT scan. These procedures also can be used to detect TIAs.

Symptoms of TIA

There are seven types of symptoms of TIAs. They include:
1. Carotid system TIAs
   • Unilateral weakness—usually hemiparesis (unilateral weakness)
   • Unilateral sensory complaints—numbness, paresthesia
     (abnormal sensations)
   • Aphasia—language comprehension, output, or both
   • Monocular vision loss
2. Vertebrobasilar system TIAs
   • Motor deficit
   • Sensory complaints (bilateral)
   • Bilateral visual complaints
3. Diplopia (double vision)
4. Dysarthria (speech and language disturbance)
5. Vertigo (dizziness)
6. Ataxia without weakness (muscle incoordination)
7. Aphasia (impaired comprehension) \(^{16}\)

*Note: 3-7 occur only in combination, not as isolated symptoms

**Cerebral Embolism**

The brain is involved in about 70% of all emboli from the heart. Cerebral embolism accounts for 20% of all ischemic strokes. Clinical diagnosis is based on the number of features. Ten percent of patients will stutter when a cerebral embolism is present. Seizures and headaches at the onset of a stroke are not as useful an indicator as once thought. \(^{15,16}\) Cardiogenic embolism should be considered when the following conditions are present: The patient’s age is over 60; there is sudden onset of maximal-neurologic deficit, prior cortical infarct, past history of valvular-heart disease, left ventricular myocardial infarct, AF, or congestive heart failure. \(^{17,18}\) Echocardiography, two-dimensional, transesophageal (TEE), M-mode, and distal subtraction are used to detect the presence of thrombi and ventricle and valve dysfunction. \(^{19,20}\)

**TREATMENT**

Physical functioning is regained through rehabilitation and physical therapy. \(^{19}\) As for pharmacologic therapy, there are a variety of options. All of the following except for “alteplase” are antiplatelet agents, which are the mainstay of ischemic-stroke prevention. They alter blood-platelet aggregation, thus, inhibiting the formation of thrombi in arterial vessels. \(^{21}\) Other than alteplase, nothing exists to treat a stroke either to prevent the initial stroke or the recurrent stroke.

**Clopidogrel (Plavix)\(^{21}\)**

- This agent decreases the rate of a combined endpoint of new ischemic stroke. The dose is 75 mg by mouth once daily.
Ticlopidine (Ticlid)21

- This agent decreases the risk of thrombotic stroke in patients who have experienced stroke precursors and also in those who have had thrombotic strokes. Serious side effects limit its use in those who are intolerant or allergic to aspirin, or who have failed aspirin therapy. The dose is 250 mg by mouth twice daily.

Aspirin/Dipyridamole (Aggrenox)21

- This agent is a combination of 25mg of aspirin and 200mg of extended release dipyridamole, which decreases the risk of stroke in those who have had TIAs or complete stroke due to thrombus. The antiplatelet effect is additive with this combination. The dose is one capsule by mouth twice daily.

Warfarin (Coumadin)21

- This agent is usually used for prevention of myocardial infarction (heart attack), but an unlabeled usage is the prevention of TIAs. Warfarin comes in many doses and is given on an individualized basis.

Alteplase, recombinant (Activase)21

- This agent is indicated for acute ischemic strokes in adults and is used for improving neurological recovery and reducing the incidence of disability. Therapy must be initiated within three hours of onset of symptoms, and after exclusion of intracranial hemorrhage by a CT scan. Alteplase is an enzyme that binds to fibrin in a thrombus and converts the entrapped plasminogen to plasmin, thus, dissolving the thrombus.
CONCLUSION

Stroke is a costly illness that can wreak great havoc on families, but it can be prevented with diet, exercise, and other positive-lifestyle changes. The devastation of stroke also can be minimized once patients learn not to ignore or deny their symptoms. If medical attention is sought within the first three to four hours, future prognosis is much better for patients. There are no “treatments” for stroke; only prevention.

REFERENCE NOTES


PART 7: COLLEGE OF SCIENCE AND MATHEMATICS
INVESTIGATING THE REDUCIBILITY OF POLYNOMIALS

Dawn B. McNair

Department of Mathematics
College of Science and Mathematics

A polynomial is said to be reducible in a given field if it can be written as a product of polynomials with coefficients in the given field. Since the early 1600s mathematicians have explored different methods and techniques to devise an algorithmic approach to whether a polynomial is reducible. A number of criteria have been developed which give valuable information for particular classes of polynomials. In this chapter, we will first examine the contribution of Rene’ Descartes, followed by a discussion of the Eisenstein Criterion, Newton’s method of fluxions, and the Dumas’ work with Newton polygons.

One of the most fundamental concepts of mathematics is factoring polynomials. Factoring allows us to re-write what appears to be a challenging polynomial into a product of monomials and polynomials. Once an individual has this product, numerous questions can be answered about real-world situations. For example, a professional photographer often needs to make different-sized photographs of the same picture. Suppose the photographer wants to reduce the length and width of the print by the same amount so that the area of the new print is one-half the area of the original print. To find the amount of the reduction, the photographer will need to use factoring.

Many mathematicians, including Menaschmus and Omar Khayyan studied the construction of roots using geometry; however, the mathematician credited with the concept of factoring was Rene’ Descartes (Boyer, 1991). Many often describe the work of Descartes as applying algebra to geometry, but in actuality, Descartes used geometrical ideas to make algebraic influences. This insight led to one of the most important concepts in mathematics and theoretical physics — the coordinate system.
Descartes’ work in mathematics known as *Discours de la Methode* appeared in 1637 (Motz & Jefferson, 1993). *La Methode* had three appendices, one of which, *La Geometrie*, discussed analytic geometry in great detail. Descartes introduced analytic geometry as a way of visualizing algebraic formulas. Descartes had related algebraic equations to spatial configurations. He not only used the coordinate system to represent spatial configuration, he also used the system to express graphically the relationship between any two quantities that are functionally related to each other (Motz & Jefferson, 1993).

These functional algebraic relationships between two quantities $y$ and $x$, where $y$ is a polynomial in $x$, allow us to examine the curve associated with the functional relationship and draw conclusions about the polynomial theoretically. For instance, if $a$ and $c$ are real numbers, then an equation of the form $y = c + ax$ in the coordinate system is a straight line. Notice, it must intersect the $x$-axis at some point and $y$ equals zero at that point (Motz & Jefferson, 1993). Thus, the function has a root at that $x$-value. Descartes determined that once you know how to find the rational roots, if they exist, you can use that information to factor the equation. We can determine the number of possible “true” and “false” roots by Descartes’ Rule of Signs.

Descartes’ Rule of Signs is presented without a formal proof in Book III of *La Geometrie*. It states:

We can determine also the number of true and false roots that any equation

can have as follows: An equation can have as many true roots as it contains changes of sign from $+$ to $-$ or from $-$ to $+$; and as many false roots as the number of times two $+$ signs or two $-$ signs are found in succession. (Smith, 1954, p. 174)

By the term “true roots,” Descartes means “positive roots;” by “false roots” he means “negative roots.”

Suppose $f(x)$ is a quadratic polynomial (degree 2 polynomial). First, we divide the polynomial by the coefficient of the $x^2$ term to make $f(x)$ monic. This
monic polynomial has the same roots and same pattern of sign changes as the original polynomial. Let the polynomial \( f(x) = x^2 + bx + c \) have two roots \( r \) and \( s \). The polynomial \( f(x) \) can be expressed in factored form by using Descartes’ Factor Theorem. It states that if \( f(x) \) is a polynomial of positive degree, then the number \( r \) is a root of the equation \( f(x) = 0 \) if and only if \( (x - r) \) is a factor of the polynomial \( f(x) \) (Smith & Latham, 1954). So, \( f(x) = (x - r)(x - s) = x^2 - (r + s)x + rs \). Notice the coefficients \( b \) and \( c \): Coefficient \( b = -(r + s) \) and \( c = rs \). Note \( c \) is only positive when both \( r \) and \( s \) have the same sign; thus, \( f(x) \) has either two positive roots or two negative roots. But if \( c \) and \( x \) are both positive, the only way the polynomial \( f(x) \) would equal zero is for \( b \) to be negative. According to the Quadratic Formula, if \( c \) is large enough, there will be no real roots. Therefore, if \( f(x) \) has two sign changes, there will be either two positive real roots or none at all. If \( c \) is negative, there will be one sign change (regardless of whether \( b \) is positive or negative) and there will be two real roots. Since \( c \) is negative this implies \( r \) and \( s \) will have opposite signs — concluding one positive root.

A similar analysis can be done for polynomials of higher degree. Descartes’ Rule of Signs demonstrates the correlation between the sign changes of the coefficients and the number of real roots of a polynomial. Thus, Book III of La Geometrie is a course in the elementary theory of equations. It tells: how to discover the rational roots, if any; how to depress the degree of the equation when a root is known; how to increase and decrease the roots of an equation by any amount; how to determine the number of possible “true” and “false” roots (positive and negative roots) through “Descartes’ Rule of Signs;” and how to find the algebraic solution to cubic and quartic equations (Boyer, 1991). We will now examine reducibility from a different approach.

Through analysis of a polynomial by the Eisenstein Criterion, we will determine if a given polynomial is irreducible. Published in 1850, Eisenstein developed a criterion for determining the irreducibility of polynomials by examining the coefficients of the polynomial. The Eisenstein Criterion states:

If in the integral polynomial \( f(x) = \sum_{j=0}^{n} a_j x^j \) all the coefficients except \( a_n \) are divisible by a prime \( p \), but \( a_n \) is not
divisible by $p^i$, then the polynomial is irreducible over the rationals. (Dorwart, 1935, p.370)

For example if $f(x) = 2x^6 + 14x^2 + 28$ and we apply Eisenstein’s Criterion for $p=7$. Notice that 7 divides 14 and 7 divides 28, but $7^2$ does not divide 28. Thus, by Eisenstein’s Criterion $f(x)$ is irreducible over the rationals.

Another contributor to the algebra of polynomials through the examination of roots was Isaac Newton who generated higher-degree polynomials by “The Binomial Theorem.” Unlike his predecessors, Isaac Newton was a master of all facets of the mathematics known at his time. Newton used arithmetic, algebra, geometry and trigonometry to demonstrate his own theorems and discoveries in physics (Motz & Jefferson, 1993).

One of Newton’s most significant mathematical discoveries was The Binomial Theorem. Unlike Euclid and Archimedes, Newton did not provide a complete proof of his Binomial Theorem (Dunham, 1947). The binomial theorem was a technique used to expand expressions of the form $(a + b)^n$, where $n$ is a real number. Until Newton, Blaise Pascal was the mathematician who dealt with the binomial expansion coefficients. Pascal observed that a pattern existed in the coefficients and further developed “The Pascal Triangle” (Dunham, 1947). However, Newton was able to devise a formula for generating the binomial coefficients without constructing Pascal’s Triangle. Newton believed if a pattern existed where $n$ is a positive real number, then the pattern should also exist in expansions of $(a + b)\frac{1}{2}$ or $(a + b)^2$ (Dunham, 1947, p. 167). Newton wrote:

$$(P + PQ)^n = P^n + \frac{m}{n} A Q^n + \frac{m-n}{2n} B Q^{n} + \frac{m-2n}{3n} C Q^{n} + \frac{m-3n}{4n} D Q^{n} + \ldots$$

where $P + PQ$ is the binomial to be expanded, $\frac{m}{n}$ is the power that the binomial to be expanded is raised, and where $A, B, C$, and so on, represent the immediately preceding terms in the expansion. In modern-day algebra classes, Newton’s binomial theorem does not appear in this format, but with further examination, one can derive what we know to be the binomial theorem. Let $A = P^{\frac{m}{n}}$. 


\[ B = \frac{m}{n} A Q = \frac{m}{n} P^\frac{\pi}{n} Q \]

\[ C = \frac{m-n}{2n} B Q = \frac{(m-n)m}{(2n)m} P^\frac{\pi}{n} Q^2 = -\frac{m}{n} \left( \frac{m-1}{2} \right) P^\frac{\pi}{n} Q^2 \]

\[ D = \frac{m-2n}{3n} C Q = \frac{(m-n-1)(m-2)}{3 \cdot 2} P^\frac{\pi}{n} Q^3 \]

and so on. (Dunham, 1947, p. 171)

Applying Newton’s formula and factoring, yields

\[ P^\frac{\pi}{n} (1+Q)^n = (P+PQ)^n = P^\frac{\pi}{n} \left[ 1 + \frac{m}{n} Q + \frac{(m-n)(m-1)}{2} Q^2 + \frac{(m-n-1)(m-2)}{3 \cdot 2} Q^3 + \ldots \right] \]

(Dunham, 1947, p. 171).

Canceling \( P^\frac{\pi}{n} \) from each side leaves

\[ (1+Q)^n = \left[ 1 + \frac{m}{n} Q + \frac{(m-n)(m-1)}{2} Q^2 + \frac{(m-n-1)(m-2)}{3 \cdot 2} Q^3 + \ldots \right] \]

(Dunham, 1947, p. 171). Newton’s binomial theorem gives us a precise way to generate expanded polynomials. It was an efficient way to get roots of any order (Dunham, 1947). After Newton developed the binomial theorem, he created his “method of fluxions” better known as differential calculus, and in 1666 he devised the “inverse method of fluxions” or the integral calculus (Dunham, 1947). The method of fluxions appeared in De Analysi, which was published in 1711 (i.e., written in 1669). In the method of fluxions, Newton used two rules to calculate how to find the area under a curve.

*Let the Base AB of any curve AD have BD for its perpendicular ordinate; and call AB = x, BD = y, and let a, b, c, etc. be given quantities, and m and n are whole numbers. Then:*

**Rule 1:** If \( ax^n = y \), it shall be \( \frac{an}{m+n} x^{(m-n)/n} \) Area ABD
Rule 2: if the value of $y$ be made up of several such Terms, the Area likewise shall be made up of the Areas of which result from every one of [the] Terms. (Dunham, 1947, pp.172-173)

In the Method of Fluxions, “Newton’s Method” for finding the approximate solutions of equations can be found (Boyer, 1991). This method is an algorithmic approach to finding the solutions to $f(x) = 0$. In Newton’s Method, the root is located between two values, $x = a_1$ and $x = b_1$, so that in the interval $(a_1, b_1)$ neither the first nor the second derivative equals zero or fails to exist. For one of these values, $(x = a_1$ and $x = b_1), f(x)$ and $f''(x)$ will have the same sign.

Without loss of generality, say $f(a_1)$ and $f''(a_1)$ have the same sign; then, according to Newton’s Method, the value $x = a_1$ will be a better approximation for the root if $a_2 = a_1 - \frac{f(a_1)}{f''(a_1)}$. This process is repeated until an approximation of predetermined precision is obtained. Newton’s Method is quite similar to the Chinese-Arabic method named for Horner, but unlike the Chinese-Arabic method, Newton’s Method can be applied to equations with transcendental functions (Boyer, 1991). The binomial theorem and fluxional method of finding areas under curves allowed Newton to analyze many mathematical and physical problems, including the estimation of the value of $\pi$. Newton’s approximation of $\pi$ using the binomial expansion was complete in nine terms. Newton calculated $\pi$ correct to seven decimals using this estimation technique.

The Method of Fluxions also discussed Newton’s Parallelogram, which was helpful in infinite series and sketching curves. The equation $\sum (m,n)x^ny^n + (0,0) = 0$ where the left series terminates given any value of $x$ and a finite number of values for $y$. So, if the highest power of $y$ in the equation is $n$, the equation can be re-written as $A_1y^n + A_2y^{n-1} + \ldots + A_n$ where $A_0, A_1, \ldots A_n$ are all integral functions of $x$. Thus, if $x$ is given any particular value $\alpha$ ($\alpha$ is real or complex), there will be $n$ corresponding values of $y$ say $b_1, b_2, b_3, \ldots b_n$; and if $\alpha$ is changed to say $a + b$, then $b_1, b_2, \ldots b_n$ will change into $b_1 + k_1, b_2 + k_2, \ldots , b_n + k_n$. Therefore, $y$ is an algebraic function of $x$.

Since every equation of the form $y = F(x)$ is an irrational algebraic function that can be rationalized, every ordinary irrational algebraic function is a branch of
an algebraic function; however, the converse does not hold. So, as long as \( x \) is not assigned in \( A_0 y^m + A_n y^{n-1} + \ldots + A_0 \), the equation is irreducible. The equation cannot have two or more of its roots equal for all values of \( x \). Notice that this irreducibility, in general, did not exclude reducibility or multiplicity of roots for particular values of \( x \) (Chrystal, 1964). Hence, it may happen that \( n \) branches of \( y \) have points in common, but it cannot happen that any two of the \( n \) branches would be exactly the same. For every value of \( x \) which makes \( A_0 = 0 \), one branch of \( y \) has a zero value, for every value of \( x \) which makes \( A_n = 0 \) and \( A_{n-1} = 0 \), two branches have a zero value; and so on. These are called zero values. For every value of \( x \) (pole) which make \( A_n = 0 \), one branch of \( y \) has an infinite value; for every value of \( x \) which makes \( A_n = 0 \) and \( A_{n-1} = 0 \), two branches have an infinite value; and so on. These may be called “infinities” of the function (Chrystal, 1964). Mathematicians wanted to show that every branch of an algebraic function is (within certain limits), in the neighborhood of every point, expandable in an ascending or descending power series and that every branch is, except at a pole, continuous for all finite values of \( x \). Newton’s Parallelogram helped in the process such that it helped to find \( q \)-expansions corresponding to \( q \)-branches, which meet at the \( q \)-pole point \( x=a \).

Dumas further developed the idea of using the Newton Parallelogram by using what is known as Newton Polygons to determine the irreducibility of polynomials. Let the coefficients of the polynomial \( f(x) = x^m + a_1 x^{m-1} + \ldots + a_n = \neq 0 \) be divisible by \( p^e \) (\( p \) is prime), and let the ordered pairs \((0,0), (1, \alpha_1), \ldots, (n, \alpha_n)\) be plotted in a rectangular coordinate system, omitting those points where \( \alpha_i = 0 \). The Newton polygon \( S \) of \( f(x) \) with respect to \( p \) is drawn beginning at the origin and ending at the point \((n, \alpha_n)\) where all the of the points lie above or on \( S \) (Dorwart, 1935). Let \( S_1, S_2, \ldots, S_e \) be the sides of \( S \), and let \( q_1, q_2, \ldots, q_e \) and \( r_1, r_2, \ldots, r_e \) be the projections of these sides on the \( x \) and \( y \) axes, where \( q_1 q_2 \ldots q_e = n \) and \( r_1 r_2 \ldots r_e = \alpha_n \). Since \( q \) and \( r \) are rational integers, there is a greatest common factor \( e, \) such that \( q_i = e, \lambda_i, \) and \( r_i = e, \rho_i, \) where \( \lambda_i \) is relatively prime to \( \rho_i \). If the first side coincides with \( x \) axis, \( r_1 = p_1 = 0, \) in this case \( \lambda_1 \) is taken to be one (Dorwart, 1935). From these Newton polygons Dumas was able to prove
the following theorem:

The polygon of a product is composed of the polygons of the factors, where the sides are ordered according to increasing slopes (Dorwart, 1935, p. 372).

As a result of this theorem Dumas' irreducibility theorem immediately followed:

The polynomial \( f(x) \) can have only those factors of degree \( m \) for which \( m \) can be represented in the form \( m=\sum_{i=1}^{e} t_i \lambda_i \), where \( t_i \) denotes one of the numbers 0, 1, \ldots, \( e \) (Dorwart, 1935, p. 372).

For polynomials in Eisenstein form, the Newton polygon is the line joining the origin to the point \((n, 1)\), and irreducibility immediately follows. Consider the example, \( f(x) = x^{10} - 7x^8 + 14x^6 - 28x^4 - 49x^2 - 21 \). We will draw the Newton Polygon of \( f(x) \) with respect to seven (See Figure 1). Notice the polygon of \( f(x) \) does not pass through any lattice points other than the point \((10, 1)\). According to Dumas' theorem this implies that the only irreducible factor of \( f(x) \) has degree ten, which is the polynomial itself. Thus, \( f(x) \) is irreducible. We will now consider an example with respect to two primes.

Suppose we wanted to determine the irreducibility of the polynomial \( g(x) = x^5 \pm 7x^4 \pm 6x^3 \pm 24x \pm 72 \) for any of the 16 combinations of signs. Examine the Newton polygons with respect to \( p=2 \) and \( p=3 \) (See Figures 2 and 3). The Newton Polygon with respect to two implies that if \( g(x) \) is reducible, then it can be written as a cubic polynomial times a quadratic polynomial. However, the Newton Polygon with respect to three implies that if \( g(x) \) is reducible then it can be written as a linear times a quartic polynomial. Therefore, there is one combination that works in both cases: \( 2+3=4+1 \); so each irreducible factor has degree five, which is the polynomial itself. We can conclude that \( g(x) \) is irreducible.

The reducibility of polynomials allows one to analyze what appears to be a complex expression in manageable parts. It further assists in determining the roots of a polynomial, which is beneficial to solving real-world problems. Although this is not an exhaustive list of contributors to the topic of reducibility,
Figure 1

Newton polygons with respect to 7

Figure 2

Newton polygons with respect to 2

Figure 3

Newton polygons with respect to 3
this monograph chapter does give the reader an idea of how geometry provides an algorithmic approach to simplifying polynomials. The methods developed by Descartes, Eisenstein, Newton, and Dumas used the rectangular coordinate system to examine reducibility through sign change(s) and the divisibility properties of the coefficients.

REFERENCES


MICROHABITAT SELECTION: EVERYBODY IS DOING IT

Maxine Henry

Marine Science Program
College of Science and Mathematics

Microhabitat selection. It's a complex name for a simple situation, and it's going on all around you, even if you aren't quite aware of it. As an example, have you heard this before: “Why don't we go sit in the sun, it's much warmer there?” Or maybe this: “That's got to be where the food is; let's head over there!” When you sit on a bench to catch the early sun in March, or when you follow the crowd to the buffet table, you are selecting your microhabitat. After all, a microhabitat is a smaller habitat within a larger habitat, while a habitat describes the place where some one or some thing normally is located. Habitats usually are given general names; thus, we have forest and desert habitats as well as urban and suburban habitats. Microhabitats are not given general names, because they can fall ever smaller into each other like the Russian babushka dolls, and within one habitat there can be a multitude of separate microhabitats.

People select their microhabitats on the basis of food availability and temperature constraints, as demonstrated in the above examples. They also use the criteria of population density (a cabin in the mountains), and mate availability (certain evening venues) to determine which microhabitats suit their needs. Use of a microhabitat may vary, depending on the time of day or season of the year. In temperate habitats, the beach is a microhabitat selected for the summer months, while in tropical habitats, the mountains may be a popular destination (microhabitat). People live and move on a scale of miles and hundreds of miles on a daily basis, so their working definitions of microhabitats may differ considerably from those of butterflies and other organisms who live on a scale of meters and centimeters (excluding large migrations). However, both groups do use microhabitats.
Understanding how organisms use microhabitats is an important part of ecology, and also impacts the human community. Conservation ecology explores issues of keeping and encouraging the diversity of organisms in a changing landscape. Many of the landscape changes are anthropogenic in nature, such as logging, controlled burnings, clearing land for agricultural use, and urban development. Some of the anthropogenic changes have the possibility of negatively impacting organismal health. As human growth continues and cities develop further into areas previously pristine, humans and animals will be, in a sense, forced to compete for that all-important resource, “space.” Residents in Florida and Illinois have now found themselves in the position of sharing their urban spaces with alligators and coyotes (Anonymous, 2003; Heyn, 2001; JBOSC Web Development Team, 2002; Siewers, 2000). Therefore, understanding what makes a microhabitat needful or attractive to organisms is important to scientists and laypeople alike.

MICROHABITAT SELECTION IN THE TERRESTRIAL ENVIRONMENT

Organisms on land and in water have to deal with very different environments, and that difference cascades down to the microhabitat level. That is why microhabitat selection on land and in water is divided into separate sections. In each section, we will examine cases of microhabitat selection, some of the constraints involved, and effects of microhabitat selection on the organisms involved.

Forest habitats might be assumed to be spatially homogeneous in composition; however, from the point of view of a small mammal, a forest contains an abundance of microhabitats that differ from each other by characteristics of tree type, understory type, and amount of canopy cover. Castleberry, Wood, Ford, Castleberry and Mengak (2002) found that Allegheny woodrats distinguished between microhabitats and were consistently found in some rather than others. They preferred microhabitats with a diversity of understory vegetation. Castleberry et al. (2002) considered that one constraint to woodrat microhabitat choice and usage would be the presence of logged areas;
the forest is a managed one. Woodrats in logged areas might be subject to higher rates of predation or may not be able to utilize the resources in logged areas. However, the study pointed out that woodrats did not discriminate against areas that had been logged. Castleberry et al. (2002) hypothesized that since the woodrats were very mobile when foraging and were diet generalists, those two characteristics minimized the effect of logged forest areas.

The woodrats mentioned above chose microhabitats on the basis of understory characteristics. One important facet of understory vegetation is that it offers places to hide from predators; yet, hiding from predators is not the only basis for choosing a microhabitat.

Huey, Peterson, Arnold, and Porter (1989) investigated the microhabitat choice of Californian garter snakes and the effect of certain choices. These snakes spend a lot of their time either under rocks or in burrows. After observing snakes, Huey et al. (1989) found that these garter snakes choose their microhabitats on the basis of temperature constraints. Because snakes are ectotherms, in order to achieve a preferred body temperature, they need to be in an area where they can either pick up or dump off body heat. The rocks and burrows that they chose consistently helped them to do so; however, not all rocks were the same type or size, and not all burrows were the same depths. By measuring metrics of preferred rocks, and by offering the snakes a range of microhabitat rocks, Huey et al. (1989) determined that rock thickness was important. Snakes picked medium-sized rocks; rocks too thick or too thin prevented snakes from achieving their preferred temperature and could cause mortality from either heat or cold stresses. In a vertical burrow, things were less complicated because the snake changed depth depending on whether heat loss or heat gain was the objective.

Hiding from predators and staying a comfortable temperature are key factors in surviving; however, mere survival pales before the opportunity to pass on genetic makeup to the next generation. It is the dream of immortality become real, or as close to reality as we can get. Finding a mate is very important both in the human and animal world.
Thomas, Parkinson, Griffiths, Garcia, and Marshall (2001) examined populations of carabid beetles in two fields of winter barley that were separated by a hedge. They found that the beetles had different areas of the fields in which they stayed consistently; although their areas changed in size, the central point did not change location. Characterizing the microhabitats used was difficult due to the differences between the scale of measurement (0.5 m$^2$) and the scale of the microhabitat characters (<0.5 m$^2$); however, Thomas et al. (2001) hypothesized that moisture patches in the sediment and the presence of certain weedy plants was attractive to these beetles. Because the populations on either side of the hedge were different, yet the fields were the same and had similar histories, Thomas et al. (2001) also determined that the hedge proved a gap, or distance constraint, that the beetles could not bridge. One benefit suggested by the stability in microhabitat choices and choosing is that mate availability remains high. Thomas et al. (2001) alluded to that when they recognized that males and females shared the same microhabitat choices at the same times.

There are situations wherein the organism that selects the microhabitat benefits from using the microhabitat, as in the cases above. There are also situations where both parties benefit. Herrera (1995) investigated such an example when he examined the relationship between the early-blooming daffodil and a major bee pollinator. This daffodil blooms from February to April, a time of year that still sees large fluctuations in temperature and may experience irregular snowfalls. The major pollinator bee is very small, and needs warm temperatures in order to have enough energy to fly. Despite these obstacles, the populations seem to see consistent pollination rates of close to 100%. When Herrera measured the temperature inside the flowers, he found that temperatures were above those of the ambient air; thus, when bees visited the flowers, they could gain thermal energy from basking within the flowers. This allowed them to pollinate more efficiently. Both benefited from the association; the daffodil had consistent reproduction success by offering a profitable microhabitat to the bees, and the bees profited when they selected the microhabitat inside the daffodil flowers.
SELECTION IN FRESHWATER, MARINE AND INTERTIDAL ENVIRONMENTS

Salamanders are interesting organisms as they sit astride the fence of being terrestrial and aquatic. Although the larval form needs to be in water, the adult form is relatively independent of a water source. Grover (2000) examined a suite of salamanders that ranged from mostly terrestrial to mostly aquatic and their relationship to a moisture gradient. Research results were that larger species chose larger rocks under which to retreat, and smaller species chose smaller rocks as retreats. Larger species also chose cooler burrows than smaller species. Grover found that three criteria were involved in these choices, desiccation, thermal, and interspecific interference constraints. Because salamanders have extremely permeable skin, desiccation is a constant threat so long as the salamander is outside of a water source; therefore, choosing rocks and burrows over exposed sites offers moisture refuges. Also, given that the thermal inertia is greater for a larger animal, the observation that the larger salamanders chose larger rocks is not unintuitive. Another reason for smaller salamanders to choose smaller rocks and burrows to shelter under is species-species interference (Grover, 2000). Some salamanders are more aggressive than others and will force another individual out of territory if it is able. For a small salamander, selecting a small microhabitat to use decreases the chance that it will encounter another individual and the exclusion behavior.

Microhabitat selection is not only the province of the adult organism. Juveniles of some groups also are adept at actively selecting their preferred microhabitat.

Adult dragonflies may be airborne, jeweled, fliers, but their larval forms live totally submerged in aquatic habitats. Wellborn and Robinson (1987) investigated microhabitat choice in dragonfly larvae from a Texas small pond and found that the larvae preferred certain regions of a water plant (i.e., Sagittaria playphylla). The specificity of this choice deserves repeating. Not only did the larvae select one certain plant, but the larvae chose one particular region on the plant. When Wellborn and Robinson included a predator into the system, results
demonstrated that larvae selected the specific microhabitat because of predation constraints. This is an example where the microhabitat offers both good and bad consequences for the selecting organism. Although the microhabitat allowed a refuge from predation, there was no food source there; dragonfly larvae were safe but potentially could starve.

For de Montaudouin's (1997) work on a marine cockle, food availability or predation risk is a less pressing need, as compared to a place to settle down and metamorphosis. He demonstrated that if juvenile cockles are stimulated to initially settle on an unsuitable piece of substrate, or in an unsuitable microhabitat, the cockles release their attachment threads (byssal threads) and ascend back into the water column until another microhabitat is reached. Because the cockle is a suspension feeder, the ability to resuspend from an unsuitable microhabitat and to continue searching for a better one is important. Microhabitat characteristics such as water velocity and amount of sediment in the water can directly affect the feeding rate and thus the growth rate, which can influence the reproduction success of this organism.

The intertidal zone is considered to be where the water and land meet. It sees the tidal influence and experiences drastic temperature and salinity changes on a regular basis. The next two microhabitat selection situations are found here.

Takada (1999) investigated community dynamics on a rocky-intertidal shore. If the low tide is synchronous with midday or midnight, in the absence of suitable microhabitats in which to take refuge, temperatures can cause stress responses from organisms. Takada (1999) erected shelters to block the sun and observed that the community structure changed. Organisms that normally would not be able to survive the thermal conditions were seen in the artificial microhabitats. In this case, the criterion for choosing a microhabitat was shade, or temperature amelioration. A direct consequence of temperatures above or below an organism's safety margins is cellular damage (Feder & Hofmann, 1999). Although not lethal, this damage can reduce the reproductive success of an organism. Intertidal organisms tend to live close to their safety margins on a daily
basis; therefore, suitable microhabitat use can be the deciding factor between biological immortality and a dead end.

Soft-sediment intertidal habitats are a flip side of rocky intertidal environments. Many times, soft-sediment systems have less energy than rocky intertidal systems, and where the rocky intertidal habitat consists of primarily hard substrate, the soft-sediment intertidal consists of fine sand, clay, or mud substrates. Avocets in South Carolina are residents of salt marshes and mudflats, both soft-sediment habitats. Boettcher, Haig and Bridges (1995) explored the habitat choices and distribution patterns of these birds in both natural mudflats and manmade impoundments in South Carolina. Results showed that avocets prefer microhabitats where the substrate was covered with 15 cm of water on average. Unlike the spatially and temporally stable crevices of Takada's (1999) rocky shore, the preferred microhabitats of avocets change spatially on the basis of a tidal cycle. Many intertidal inhabitants are affected by the tidal flow and some migrate through interstitial spaces in the sediment depending on the tidal level (Kingston, 1999). This can lead to a moving wave of microorganisms, or other prey items, across mudflats and bays that could be influencing the microhabitat selection of these avocets.

**ONE CAVEAT**

Many of the studies above involved sampling areas to determine if organisms were present in different microhabitats. Some of the sampling went on for months, but sampling was done at discrete intervals and the organisms were not monitored over large-time scales (however, see Castleberry et al. [2002]). Crowe (1996; Crowe & Underwood, 1998) examined snail distributions, microhabitat choices, and barriers to dispersal, to find that a certain distribution of organisms is not always a definite indicator that the microhabitats being used are preferred and actively selected. Factors such as differential mortality may be the reason behind the distribution observed (e.g., Amspoker & McIntire, 1978; Gordon & Desplanque, 1983), and Crowe (1996) warned against immediately assuming that an organism is selecting a microhabitat without properly controlled experimentation.
MICROHABITAT SELECTION AND CONSERVATION

The two subjects, research on microhabitat selection and conservation efforts, have the potential to be two hands of the same entity. An example of this is given by the study done by Boettcher et al. (1995) referred to above. In many parts of the United States, wetlands are decreasing due to human consumption. Manmade impoundments were designed to mimic wetlands, and the work of Boettcher et al. (1995) demonstrated that such efforts could ameliorate the negative impacts of wetland loss on American avocets. However, the fact remains that such effects were not strong enough, by themselves, to reverse those negative impacts.

Brooker, Brooker, and Cale (1999) give another example of the complementarity possible between microhabitat selection and conservation. In the Western Australia Wheatbelt, the native habitat has been fragmented by agricultural fields to the point where native vegetation appears as patches between cultivated fields. For populations of Blue-breasted Fairy-wrens and White-browed Babblers in that area, suitable microhabitats consisted of native vegetation at varying plant densities, while agricultural areas were unsuitable (Brooker et al., 1999). Measurements taken in and around the patches showed that distances between suitable microhabitats could be obstacles to dispersal for the birds. The birds would not cross certain distances if those distances took them through unsuitable microhabitats (Brooker et al., 1999). Predation risks could be higher in the more ordered-field environment due to less places to hide that are temporally stable. Brooker et al. (1999) showed evidence that data about microhabitat choices and critical distance should not be ignored and should be employed when designing management strategies.

The land mullet, a medium-sized lizard reaching adult lengths of around 30 cm, is associated with the remnant rainforest habitat in Australia. Due to the clearing activities that decrease rainforest habitats, Klingenböck, Osterwalder, and Shine (2000) hypothesized that the land mullet may be negatively affected. To address that concern, Klingenböck et al. caught and inserted transmitters into individual lizards to examine their microhabitat choices. They found evidence
showing that land mullets prefer small clearings in the forest and also areas with fallen logs. Since lizards are ectotherms, they need areas where they can bask, taking up heat from the sun to raise their body temperature enough to begin foraging. Clearings in a forest, whether natural or man-caused, are areas that land mullets are able to utilize as basking areas. Fallen logs double as basking spots and also refuges from adverse weather conditions or predation (Klingenböck et al., 2000). From their microhabitat-choice work, these researchers were able to determine that the land mullets were not hindered by anthropogenic activity, unlike the birds examined by Brooker et al. (1999). In fact, Klingenböck et al. (2000) hypothesize that land mullets may use the logging roads to exploit areas deeper in the forest that they would otherwise not be able to use due to thermoregulatory constraints.

MICROHABITAT SELECTION AND CLIMATE CHANGE

Habitats change on a regular daily and seasonal basis. There is also a 19-year cycle in climate temperatures that can influence local organismal distributions (Denny & Paine, 1998); however, research is now demonstrating that there is a global climate change beyond the normal cyclic behavior. Research on microhabitat selection can be used to help explain population movements over time. Local cooling or warming can cause stable microhabitats to change spatially, which would affect population distributions (Barry, Baxter, Sagarin, & Gilman, 1995). Ordinarily, these effects would be location specific, but not according to the latitudinal gradient, as has been previously assumed. Helmuth, Harley, Halpin, O’Donnell, Hofmann, and Blanchette (2002) demonstrated factors such as the synchronization of low tide and midday are related to the degree of stress experienced by intertidal organisms. This is an indication that some areas will feel any global change more strongly than others.

In an example from a contrasting habitat, the desert, Wolf (2000) explores the problem faced by desert birds. Under hot-daily conditions, these birds spend a lot of their time in shaded refuges to prevent overheating and extreme water
loss. Given a scenario of increased daily temperatures beyond the norm, birds will face the choice of either foraging despite the heat and risking death, or decreasing daily foraging times and suffering a decrease in fitness due to starvation. They also may face the situation that the microhabitats once used as refuges will experience a temperature increase. Thus, even in the refuges, birds may still be subject to extreme water loss due to evaporation (Wolf, 2000) and death as a result. Knowing the microhabitat constraints experienced by these birds will help desert ecologists predict whether these birds will move to a different habitat or experience local extinctions under conditions of climate change.

**SUMMARY**

The above examples have given an overview of who actively selects microhabitats and some influential elements making up the microhabitats. Organisms select their microhabitat on the basis of many criteria among which are food and mate availability, predation avoidance, and thermoregulation. The above examples also help to illustrate that a global climate change may affect population distributions via habitat changes.

Scientists investigate microhabitat selection in different ways. In many of the examples above, the scientists sampled the microhabitat in nature and gave organisms different microhabitats to choose from in the laboratory. Two other methods to which I alluded also are helpful for scientists.

One of the methods, thermal modeling, involves exploring how the environment affects the internal-body temperature of the organism and what abiotic factors can prevent the organism from achieving that preferred temperature (Calder, 1975; Huey et al., 1989; Porter & Gates, 1969). Helmuth (1998) used thermal modeling in order to elucidate benefits of being aggregated over solitary in the case of an intertidal mussel, and Porter, Mitchell, Beckman, and DeWitt (1973) used thermal modeling to explore ecological implications of different climates on organisms and their body temperatures.

The other method is to use physiological indices such as levels of cellular
damage, oxygen-consumption rates and changes in metabolism products. These indicators can change depending on the external surroundings of the organism. One way to see the amount of cellular damage caused by microhabitat environment is to examine levels of chaperone proteins (Hofmann, 1999). These are proteins that assist in refolding other proteins that have been damaged by environmental conditions. Feder, Blair and Fiegras (i.e., fruit fly larvae in rotting fruit, 1997) and Choresh, Ron, and Loya (i.e., sea anemones in tide pools and subtidal areas, 2001) showed that increased microhabitat temperatures could mobilize chaperone proteins. Conditions such as presence of heavy metals and pollutants also could cause increased levels of chaperone proteins (Downs, Fauth, & Woodley, 2001), as well as changes in salinity (Spees, Chang, Synder, & Chang, 2002).

Levels of oxygen consumed by organisms can change depending on environmental conditions, as can the products of metabolism. The amount of change in oxygen consumption and metabolite production can be used to determine the suitability of a microhabitat. Humphreys (1975) demonstrated that wolf spiders demonstrate an increased rate of oxygen use when temperatures were above normal and also when the temperatures fluctuated in their microhabitats. This increase also was seen in intertidal snails when they experienced incidents of local salinity decrease (Liu, Stickle & Gnaiger, 1990). Changes in pH affected oxygen consumption and metabolite production in crayfish, as shown by Ellis and Morris (1995), and changes in available oxygen in the microhabitat also affected which metabolites were produced in the terrestrial tiger-beetle larvae, according to Hoback, Podrabsky, Higley, Stanley, and Hand (2000).

CONCLUSION

We know that microhabitat selection happens and that we can quantify results of microhabitat selection on the organism. However, questions still remain. What is the mechanism that relates the environment to the organism? How do organisms average out the fluctuations in their environment? Do
organisms respond to average or the extreme conditions? Can they predict and act upon the future of their microhabitat based on past experience? Tools are being developed to begin addressing these questions. The study of microhabitat selection has far to go.

REFERENCES


‘Yabby’ *Cherax destructor*: Acute and chronic changes in haemolymph oxygen levels, oxygen consumption and metabolite levels. *Journal of Experimental Biology*, 198: 409-418.


**Acknowledgments**

R. Gettone lit the fire, and B. Helmuth kept adding fuel.