

ABSTRACT

Title of Document: **BLACK/AFRICAN AMERICAN STUDENTS’
PERCEPTIONS OF MATHEMATICAL
SUCCESS AND MATHEMATICAL SUCCESS
FACTORS AT A COMMUNITY COLLEGE**

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The purpose of this dissertation was to examine Black/African American students’ perceptions of mathematical success and the various factors that they perceive to attribute to this success within a community college setting. The two major research questions guiding this study were:

1. How do mathematically successful, Black/African American students define mathematical success?
2. What are the factors (e.g., sociocultural, institutional, personal and disciplinary) that mathematically successful Black/African American students identify as directly impacting their mathematical success within a community college environment?

The study also sought to answer the following subquestion regarding mathematical success factors as perceived by the students:

2a. What are Black/African American students' perceptions of the relationship between these factors (e.g., sociocultural, institutional, personal and disciplinary) and their individual mathematical success at the community college level?

The study sought to understand a variety of success factors including sociocultural, institutional, personal, and disciplinary factors, as the students perceived them to impact their mathematical success at the community college level. Through qualitative methods and a case study design, the current study has gained insight into the mathematics education of six, high-achieving African American students at the community college level. Data has been collected through individual and focus group interviews with African American students who have successfully completed several mathematics courses (e.g., Calculus I, Calculus II, etc.) at a predominantly White, community college in the Mid-Atlantic region of Maryland. Interview data from the six participants was collected, transcribed, and analyzed drawing from sociocultural perspectives.

Findings indicated that these students perceived various disciplinary, personal, and sociocultural support factors to directly impact their mathematical success at the community college level. Throughout several identified success factors, major findings included an ethic of caring conveyed to students through social interactions with others and a perceived relationship between mathematical success and liking mathematics as a discipline. The results of this study should help to inform the current understanding of African American success and achievement in the area of

collegiate mathematics. Various implications for practice, policy, and research in this area are also presented.

BLACK/AFRICAN AMERICAN STUDENTS' PERCEPTIONS OF
MATHEMATICAL SUCCESS AND MATHEMATICAL SUCCESS FACTORS AT
A COMMUNITY COLLEGE

By

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Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2007

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DEDICATION

In Memory of my maternal grandmother, Daisy Lewis Blake;

Thank you for the legacy of the value of education. Your wisdom and faith lives on.

ACKNOWLEDGEMENTS

There are many people who have assisted me in many ways along the journey to completing this dissertation project. First and foremost, I would like to thank God for giving me the means, courage, and strength to persevere through difficulty. I thank Him for placing in my life such wonderfully supportive family and friends who have been there for me every step of the way. To my parents Jacinta and Stanley Marshall, thank you is not enough. Thank you for your unconditional love, guidance, and support throughout my life. Without your influence and example, this would have remained a dream. To my son Aaron Marshall: thanks for being the light of my life. Your hugs continue to remind me of my purpose. To my brother Brian Marshall, thanks for believing in me and always being there. You are my first best friend. To my favorite uncle Dr. Horacio Lewis, thanks for paving the road and being there when I needed to vent and talk things through. To my brilliant cousins and future scholars: Benjamin Lewis, Sonrisa Lewis, and Natasha Ryals: may the legacy continue through you and yours. To my cousin Sheena Lewis: thanks for continuing to demonstrate that perseverance, hard work, and determination can lead to continued success. To the many extended family members who have cheered me on, bragged about my efforts, and always asked about my progress: thank you for your help and support. We have finally made it!

I am truly blessed that God has allowed many compassionate friends to remain with me throughout this season. You have all helped me in some way to reach this goal. Thanks for the encouragement, support, and necessary downtime. To my

friends who have traveled this road before and have succeeded: Dr. Melanie Smith and Dr. Katina Stapleton: you are my inspiration. To Grace Benigno, thank you for all you did to smooth the way. God has blessed me with your friendship throughout this process. You have inspired and supported me in more ways than I can count. Much love girl! To Kristy Blocklin, we started this way back when! Thanks for being there through all those courses, proposal defenses, etc. You are a true friend. To Rodney Harrell: thank you for always being there.

My colleagues were extremely supportive throughout this process. Without the support of my supervisors, deans, and fellow math faculty, this would not have been possible. Thank you foremost to Dr. Daniel Symancyk, my former department chair and dean. Thank you for being an excellent department chair and for wholeheartedly supporting my degree completion and this work. Thank you to my current department chair, Alicia Morse. Your efficiency, understanding, guidance, and support have been extremely helpful. You have made the process of completing a dissertation while taking on a new job seamless. Thank you also to the many colleagues who helped me find participants for this study. A special thanks to Dr. Jagmohan Kapoor and Dr. Charles Davis, who put forth considerable effort to find these elusive participants. Without your efforts, this would not be possible. Thank you also to my colleague Mike Lueke, who assisted with the process of data analysis. Your insight was most helpful. To Dr. Roni Ellington, thank you for your advice, insight, and examples of scholarship and perseverance. A special thanks to my dissertation advisor Dr. Fries-Britt. Your guidance, direction, and support were invaluable. Thanks for all those extra talks about life; you are truly an inspiration.

Thank you to my academic advisor Dr. Graeber, for being there and believing in me throughout the entire journey. Your example and support has helped me to achieve this goal. To Dr. Fey, thank you for your advice and for setting an excellent example for me to follow. To Dr. Lynn, thank you for cheering me on and encouraging me even from a distance. To Dr. Holcomb-McCoy, thank you for being flexible and willing to serve on my committee. Your contributions are invaluable. To all the participants, thank you for taking the time to honestly share your stories.

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CHAPTER 1: INTRODUCTION

Low achievement for minority students in the area of advanced mathematics, has long had a major impact on the limited number of African Americans and other minorities pursuing careers in fields requiring advanced degrees in mathematics and science (American Institutes for Research, 1998; B. F. Lewis, 2003; Maton & Hrabowski, 2004; National Science Foundation, 2004). In 1998, only 12% of degrees conferred in science, mathematics, and engineering were awarded to African Americans, Latinos, and Native Americans. Recently, this has become a significant problem on a national level, as the United States (US) will need to train 1.9 million workers in the sciences within the next decade (National Science Board, 2002). A lack of minority persistence, interest, and enrollment in these programs is a major obstacle to meeting these needs. To increase minority participation in the sciences, educators call for strengthening the educational pipeline at the precollege (elementary and secondary) levels, where interest in mathematics and the science tends to develop initially. Partnerships between elementary, secondary and community college institutions have begun to meet this challenge (Chang, 2002).

Traditionally, African American students have been the lowest performing ethnic group in the area of mathematics across all grade levels (Education Trust, 2003; Harrell & Forney, 2003; M.L. Johnson, 1984; Oakes, 1990; Reese, Miller, Mazzeo, & Dossey, 1997; Stevens, 1995). The disparity between the achievement of African American students and Caucasian students, frequently referred to as the achievement gap, is also evidenced among various measures of mathematics achievement (Hoffman, Llagas, Snyder, 2003; National Assessment Educational

Progress, 2000; U.S. Department of Education, National Center for Education Statistics, 2004). Despite efforts to decrease the gap, minimal change has been observed in the upper grades, as students begin to study higher-level mathematics (Education Trust, 2003; Hoffman, Llagas, Snyder, 2003).

Discussions concerning the achievement gap among researchers and scholars have previously focused on disparities in achievement, failing to consider characteristics of “environments that promote high achievement among African Americans” (Perry, Steele, & Hilliard, 2003, p. 6). Although tracking and teacher expectations have been previously linked to low achievement among African American students, several scholars argue for more attention to be placed on family, student, and community factors (Perry, Steele, & Hilliard, 2003). Various researchers have begun to explore this issue by examining high-achieving African American students and the factors that attribute to their success (Fries-Britt, 1998; D. Martin, 2000; Maton & Hrabowski, 2004; Moody, 2004; Powell-Mikle, 2001; Thompson & Lewis, 2005).

Rationale

Studying successful African American students is consistent with a strengths-based approach as discussed by Maton and Hrabowski (2004) and Maton, Schellenbach, Leadbeater, and Solarz (2004). This approach differs from the traditional deficit model (Ogbu, 1986) in which the academic disparities between various ethnic groups are examined with minimal direction for intervention and improvement. As a result of a deficit approach, many scholars and educators are left with a feeling of hopelessness and helplessness (Thompson and Lewis, 2005).

According to Maton and Hrabowski (2004), “If the emphasis of many scholars on the deficits of Black youths and their families is to be counteracted, it is critical to focus on their respective strengths and to understand how these strengths are developed and nurtured” (Maton & Hrabowski, 2004, p. 553). By examining the achievement of successful African American students in mathematics, for example, we may better understand how success is achieved in this content area. This understanding can enable us to promote and sustain academic environments that support and nurture this success.

Learning from the Experts

Learning from experts has long been instrumental in understanding how students learn in a variety of content areas (Bucci, 2002; Owen & Sweller, 1989; Shoenfeld & Herrmann, 1982). Bucci (2002) describes how the stories of expert teachers can provide new teachers with a knowledge base for improving instruction. Likewise, examining the differences between expert and novice problem-solvers has informed our understanding of how to improve problem-solving capabilities among the inexperienced. For example, Owen and Sweller (1989) discuss the knowledge gained from expert problem-solvers possessing unique schemas. These schemas allow them to classify problems and apply methods of solution appropriately. Likewise, Shoenfeld and Herrmann (1982) emphasize classification in problem solving by experts, suggesting that advanced mathematics students are more apt to classify and successfully solve problems as a result. When these techniques are compared to those of novice problems-solvers, additional knowledge can be gained. Similar to the knowledge and understanding gained from expert teachers and problem solvers,

knowledge can also be gained from studying mathematically successful, African American students. As a result of this knowledge and understanding; researchers, scholars, and educators can become better equipped to assist in increasing instances of mathematical success among African American students, while decreasing the ever-present gap in mathematics achievement.

The College Achievement Gap

Although the achievement gap is evidenced throughout the pre-college pipeline, gaps in achievement between African Americans and other ethnic groups are also apparent at the college level. Although the percentage of African American students attending institutions of higher learning is on the rise, the achievement gap continues to be evidenced when African American students are compared to their Caucasian counterparts. During the 1999-2000 school year, Caucasians earned the largest proportion of college degrees nationally when compared to other ethnic groups (Hoffman, Llagas, & Snyder, 2003). This is consistent with college dropout rates throughout the 1990's, which were 20-25% higher for African Americans than Caucasians on a national level. Among those students that did graduate, grade point averages (GPAs) for African American students came in two-thirds of a grade below Caucasian students' GPAs (Perry, Steele, & Hillard, 2003). In the area of mathematics, this trend is echoed as Caucasian students have been found to score higher than African American students on mathematical knowledge tests during the first three years of college (Flowers & Pascarella, 2003). In an effort to decrease the achievement gap at the college level and improve the academic success of African American students, Flowers and Pascarella (2003) propose a qualitative line of

inquiry examining how the college experiences of African American students influence learning and academic growth at the college level.

Low graduation rates and GPAs among African American college students might be attributed to a lack of adequate academic preparation for college coursework. Increasingly, college students are beginning their studies lacking the necessary skills and prerequisites for academic success at the college level. This is evidenced by large numbers of college students requiring remediation upon admittance (McClory, 2000; U.S. Department of Education, 2003). Among Maryland students requiring remediation, a whopping 27% requiring remediation in math are freshman who have completed a high school course of study corresponding to admittance requirements of the University System of Maryland (Maryland State Higher Education Commission, 2003). This problem of underpreparedness has become even more critical as a majority of the students requiring remedial education are minorities. At California State University, African Americans (followed closely by Hispanics) continued to comprise the largest percentage of remedial students throughout 1999 (McClory, 2000). This pattern is also evidenced within the state of Maryland. In a study of Maryland public colleges and universities for the 1994-1995 school year, 75% of African Americans attending community colleges and over 40% of those attending four-year institutions required and utilized remedial programs. These numbers were significantly larger than any other ethnic group seeking remedial assistance in the state of Maryland (Maryland State Higher Education Commission, 1996). As expected, increasing numbers of African American students requiring remediation suggests that fewer African American students are matriculating and

graduating from these colleges and universities. Only 49% of African American students are successfully graduating within six years from the University of Maryland at College Park compared to 68% of Caucasian students (Education Trust, 2003). As more students begin to pursue higher education lacking adequate preparation and skills, community colleges are increasingly becoming an option to consider.

The Role of Community Colleges

When applying to four-year colleges and universities, underprepared, African American students are often being redirected to community colleges. Community colleges may be better equipped to meet their needs as they readily provide students direct access to a variety of comprehensive and remedial educational programs, smaller class sizes and increased academic support. In addition, the affordability of a community college education has recently led to the growth of these institutions as a viable alternative for marginalized populations in search of a college degree. Likewise, the community college's minimal or nonexistent entrance requirements and low tuition costs are increasingly attracting a large number of underprepared and economically disadvantaged students; including minorities. Within the state of Maryland, community colleges enroll over 38% of all undergraduate students, while over 43% of all African American undergraduates are enrolled in a community college institution (Maryland State Higher Education Commission, 2003). This recent trend suggests that more attention be given to academic achievement and persistence among minority students within community college environments.

A significant goal of the community college is to prepare students to transfer to a four-year institution in pursuit of a bachelor's degree (McClory, 2000). Steps

towards the achievement of this goal have been evidenced within the state of Maryland. Research conducted by the Maryland Higher Education Committee (MHEC) indicates that the percentage of community college transfer students receiving bachelor's degrees within four years at Maryland public institutions had increased to its highest percentage rate of 48.3% during the 1998/1999 school year (Filipp, 2004). Similarly, GPAs at the transfer school within the first year have steadily increased for all students, including minority and African Americans. Among the class of 1997, 32% of Maryland community college students transferred to a four-year institution and graduated with a four-year degree within four years of transferring (MHEC, 2003). Graduation rates and academic performance for minority community college transfer students has also steadily increased within the state of Maryland. Among African American transfer students, graduation rates have increased to 36.4 %; the highest percentage in the state's history (Filipp, 2004). Most impressive is that the graduation rate of minority community college students transferring to four-year institutions in the 1998/1999 school year was over 3% higher than minority transfers in the 1991/1992 school year (Filipp, 2004). These results suggest that community colleges may play a major role in closing the achievement gap at the college level.

As the population of minority students attending community colleges increases, community colleges are becoming responsible for preparing a large number of minority students for academic and career success. In an effort to address the issue of low minority participation in the fields of science, mathematics, and engineering, community colleges must take on the additional responsibility of successfully

graduating minorities in these fields (Chang, 2002). For this reason, a conscious effort should be made to better understand the nature of the community college experiences of minorities studying in these areas.

Researchers have long been concerned with a variety of issues related to the underpreparedness of college students such as insufficient high school preparation and the need for remedial and developmental education (MHEC, 1996). Still, others feel a need to examine overall student learning, academic achievement, growth, and persistence within the college setting (Burdman, 2003; Bush, 2004; Bush & Bush, 2005; DeSousa, & Kuh, 1996; Flowers & Pascarella, 2003; Fullilove & Treisman, 1990; Hagedorn, Maxwell, & Hampton, 2001-2002; T.L. Johnson, 2001; MacKay & Kuh, 1994; Swigart & Ethington, 1998; Swigart & Murell, 2001; Treisman, 1992; Von Destinon, Ganz, & Engs, 1993; Watson & Kuh; 1996). According to Pace (1984), academic growth for students is influenced more by what students actually do once they arrive at college, versus what they bring to college. This suggests the importance of examining student learning and academic success within the college setting. As more minority students are attending community colleges, future research is necessary to better understand student learning and academic success among these students within the community college context.

As a student population, African Americans have recently begun enrolling in community colleges at a much higher rate than Asian and Caucasian college students (Chenoeth, 1998; Nettles, 1998). The African American community has begun to acknowledge that the small-scale setting of a community college can enhance a student's chances of entering their choice of a four-year college or university

(Burdman, 2003). McJunkin (2005) speaks to the significance of the community college within the African American community as he describes “the central role that community colleges continue to play in providing educational and vocational opportunities for African Americans” (McJunkin, 2005, p. 251). African Americans now consider community colleges as the main gateway to higher education (Lewis & Middleton, 2003). Lewis and Middleton (2003) implore researchers to examine the community college setting in an effort to improve the collegiate and academic experiences of African American students.

Although several studies have examined the academic achievement of African American college students (Desousa & Kuh, 1996; Flowers & Pascarella, 2003; Fries-Britt, 1998; Fullilove & Treisman, 1990; MacKay & Kuh, 1994; Moody, 2004; Powell-Mikle, 2001; Steele & Aronson, 1995; Treisman, 1992), few studies explore the academic achievement and persistence of these students within a community college setting (Bush, 2004; Bush & Bush, 2005, 2005; Green, 2003; T.L. Johnson, 2001; Von Destinon, Ganz, & Engs, 1993). The current study sought to examine the mathematical experiences of this population of students within the context of a community college setting.

Statement of Purpose

The purpose of this study was to examine Black/African American students’ perceptions of their mathematical success and the various success factors that they perceive to contribute to this success. The study sought to understand a variety of success factors including sociocultural, institutional, personal, and disciplinary factors, as the students perceived them to impact their mathematical success at the

community college level. It is my hope that understanding the nature of these factors will increase the future success rates of African American students in mathematics and mathematics-related fields. In addition, the results of this study should help to inform the current understanding of African American success and achievement in the area of collegiate mathematics.

Through qualitative methods and a case study design, the current study has gained insight into the mathematics education of six, high-achieving African American students at the community college level. Data has been collected through individual and focus group interviews with African American students who have successfully completed several mathematics courses (e.g., Calculus I, Calculus II, etc.) at a predominantly White, community college in the Mid-Atlantic region of Maryland.

Research Questions

This study is guided by three research questions. They are as follows:

1. How do mathematically successful, Black/African American students define mathematical success?
2. What are the factors (e.g., sociocultural, institutional, personal and disciplinary) that mathematically successful Black/African American students identify as directly impacting their mathematical success within a community college environment?
 - 2a. What are Black/African American students' perceptions of the relationship between these factors (e.g., sociocultural,

institutional, personal and disciplinary) and their individual mathematical success at the community college level?

Understanding these factors may provide direction for structuring mathematical learning environments that can support and nurture student learning. What follows is an explanation of the theoretical frameworks and perspectives that guided this study.

Theoretical Framework

Several theories were drawn upon which contributed to the theoretical framework of this study. Among the theories consulted were socioiocultural theory, constructivist theory, and emergentist perspectives. These theories were utilized independently and collectively to assist with developing the current study's research design. In addition, these theories were drawn upon appropriately and used as a lens for analyzing the data collected. The following is a detailed discussion of each theory and how it was drawn upon to contribute to the current study's research methodology and findings.

Sociocultural Theory

The design of this study was guided primarily by a sociocultural framework. A sociocultural perspective not only views learning as a cognitive process, but also examines how social, cultural, and community contexts impact student learning (Germain, 1991). This framework was drawn upon in response to various scholars and researchers such as M.L. Johnson (1984), who argue for research paradigms that consider the impact of sociological factors and learning context. Likewise, this

perspective has been used successfully by Tisdell (2000) to examine how student-faculty relationships, classroom culture, and school structure influence students' learning experiences. Similarly, Rogoff (1995) views learning from a sociocultural perspective as an interaction between individuals and environmental contexts. Within this framework, I perceive African American students to be individuals interacting with others in the context of a community college environment. As members of a minority group within a predominantly White institution, African American students participate in social interactions with students and faculty of other races, members of the larger African American community, and society as a whole. From a sociocultural perspective, I sought to explore how these African American students perceived certain sociocultural factors to impact their mathematical success at a community college.

How African American students conceptualize their mathematical success in learning school mathematics has previously been linked with school and mathematical experiences (D. Martin, 2000; Moody, 2004; Powell-Mikle, 2001). Several researchers have described the African American school experience as bicultural, in that African American students must conceptualize academic success as being consistent or inconsistent with their own cultural and/or social identities as African Americans (Boykin, 1986; Fordham, 1988; Moody, 2004; Powell-Mikle, 2001; Prager, 1982). For example, many African American students may perceive mathematics as a discipline for Whites only (M. L. Johnson, 1984) and as a result, tend to view mathematical success in opposition to their own culture (Moody, 2004). This is reinforced by Western images and a hidden curriculum that typically portrays

mathematicians as White, Eurocentric males while discouraging African American and female participation and success in mathematics (Brand, Glasson, & Green, 2006; Powell-Mikle, 2000). In an effort to remain in kinship with their affiliate ethnic group, many African American students will refuse to conform to the values of the dominant culture and may consistently perform poorly in academic situations (Fordham, 1988; Ogbu, 1986). These students' perceptions of the differences between their culture and that of the dominant group can become an important construct in their mathematical success (Moody, 2004). Perceived differences in culture, suggests a sociocultural framework for the analysis of mathematical success and mathematical success factors among these students.

Ladson-Billings (1995) argued that among African Americans, academic and cultural success are intertwined within certain settings where school experiences are characterized by student alienation and hostility. She argued that past theoretical frameworks have failed to adequately explain student success among African Americans, falling short of including "larger social and cultural contexts of students" (Ladson-Billings, 1995, p. 483). To achieve and maintain academic success, African American students may pay a cultural and/or psychosocial price such as isolation from other African Americans (Fordham, 1988; Fries-Britt, 1998; Ogbu, 1986). These negative social interactions and experiences have been shown to have both positive and negative effects on their mathematical success (D. Martin, 2000; Moody, 2004) suggesting a need to further examine the nature of these interactions.

The Role of Social Interactions from a Sociocultural Perspective

Organized interactions between students, such as study groups have previously been linked with mathematical success among African American students studying collegiate mathematics (Bonsangue, 1992; Fullilove & Treisman, 1990; Treisman, 1985). Perhaps it is the nature of such social interactions that gives rise to individual mathematical success among this population. Similarly, mathematical success through organized study groups is also consistent with the Vygotskian perspective as advanced by Van Oers (in press), suggesting a link between collective and individual processes. From the organizational features of social activities that students partake in, each student's quality of thinking is derived (Van Oers, in press). Since social interactions were identified and discussed by participants as factors related to their mathematical success, the analysis of interview data has drawn from aspects of Vygotskian sociocultural perspectives which suggest that social interactions and activities can provide environments whereby mathematical learning occurs.

Like organized social interactions within the community college setting, each individual student's participation in activities within the community was also discussed as it related to mathematical success, culture, and cultural group affiliations. To understand the nature of these activities, a sociocultural framework was appropriate. From this perspective, emphasis is placed on social and cultural processes as opposed to individual knowledge construction (Cobb & Yackel, 1995). This is consistent with the idea that knowledge is primarily social and then becomes internalized (Vygotsky, 1960). Several examples of such organized social activity

whereby learning occurred included peer interactions, interactions with parents, and student-teacher interactions.

Previous research has indicated that positive student-teacher interactions have contributed significantly to the mathematical success of African American, high school students (Gutierrez, 2000). This is evidenced as one considers a negotiation of mathematical learning between teachers and students. Within this negotiation, the teacher's role becomes one in which it is his or her duty to provide culturally appropriate insights and activities for students as a medium through which they can reconstruct mathematical meanings (Cobb & Yackel, 1995). The teacher negotiates the tension between personal and culturally established meanings, such as those belonging to an established mathematical culture (Cobb & Yackel, 1995). In many cases, it is an opposing cultural frame of reference that problematizes the learning of mathematics for African American students. This frame of reference is often perceived by both teachers and other students to be in direct opposition to traditional mathematics classroom norms (Stiff, 1990; Stiff & Harvey, 1988). Further complicating matters, is apathy or ignorance on the part of many mathematics educators who fail to understand their African American students' cultures. This lack of knowledge and understanding among teachers prevents the integration of mathematical content with daily cultural activities that demonstrate the instrumentality and relevance of the discipline (D. Martin, 2000; Tate, 1994). These and other instructional issues suggest a need to examine the nature of various social and cultural interactions between students and teachers as they may provide a context

for learning negotiations to occur. Various cultural meanings specific to African American students may directly impact the nature of this negotiation.

Sociocultural Theory: Historical, Cultural, Political, and Community Influences

Crawford (in press) examines social and cultural differences and their effect on the learning of mathematics. This study explored the differences between Aborigine and American children learning school mathematics in an American setting. Results demonstrate how cultural differences based on what Aborigine students value, consistently make it difficult for them to learn school mathematics within an American context. Cultural differences such as these can become extremely problematic when one considers that from a sociocultural perspective, learning can be viewed as a transmission of culture (Cobb & Yackel, 1995). I argue that similar cultural differences might exist between African American students and others within a predominantly White, community college environment. Devoid of any attempt to assume that African American students share a homogenous culture, I propose that various cultural differences may have a direct impact on the way in which African American students may learn and succeed in the study of advanced mathematics. The cultural bases of their personal experiences may differ from those of other ethnic groups. From this perspective, mathematical success as it related to culture, was also examined.

Wertsch (1991) describes a sociocultural approach to mind as a way “to explicate how human action is situated in cultural, historical, and institutional settings” (Wertsch, 1991, p. 119). In this spirit, the current study sought to explore how mathematically successful, African American students, perceive their success as

it is directly impacted by certain success factors. Since a vast number of these factors are sociocultural in nature, I argue that the way in which each student responds to or interacts with and amongst these factors is situated within their cultural and historical background. I chose not to ignore the fact that these students are also situated within a predominantly White, community college environment. From this perspective, the nature of these interactions was considered.

Vygotskian theory, from a sociocultural perspective, proposed an analysis of individual mental functioning as that which is underlied by social processes. In other words, higher mental functioning was described as primarily social in nature. For this reason, one must understand the social relations in which the individual exists to understand the individual (Vygotsky, 1981). According to Wertsch (1991), this claim failed to consider “broader historical, institutional, or cultural processes such as class struggle, alienation, and the rise of commodity fetishism” (Wertsch, 1991, p. 46). The results of the current study will contribute to existing literature providing insight into the mathematical experiences of Black/African Americans as a minority group and marginalized population having experienced struggle and alienation in this country.

Although African American students are currently attending colleges and universities in higher numbers, they consistently perform at lower academic levels than Caucasians and other ethnic groups. As African American (and minority) students within a predominantly White setting, an effort was made to understand the nature of their mathematical success as it might relate to social interactions unique to these individuals in context. This study also sought to understand how successfully learning college mathematical content is related to cultural and community factors

specific to Black/African Americans and community college institutions. This mode of inquiry may begin to address a gap in Vygotskian theory which also fails to consider “how the mental functioning of the individual is linked to cultural, historical, and institutional contexts.” (Wertsch, 1991, p. 47).

Another major theme of Vygotsky’s work as discussed by Wertsch (1991), included a reference to the ways in which “various forms of mediated intermental functioning are related to sociocultural contexts.” (Wertsch, 1991, p.47). Minick (1985) also discussed how individual actions are as significant as small group actions, as the individual is perceived to be a member of a larger social system. He argued that individual, intermental, and social interactions are defined and structured by a broader social and cultural system. These perspectives are extremely relevant to the current study which explored a small group of African American students and their individual perspectives on studying and learning mathematics successfully at the community college level. The information that they provided will offer insight into how they have managed to successfully learn mathematical content within this setting. It is my belief however, that the information gathered in this manner is not isolated from each student’s position as a member of a larger social and cultural system. From this perspective, the relationships found between learning mathematics and various social interactions supported a sociocultural framework of analysis.

Sociopolitical aspects of teaching and learning mathematics may also impact the mathematical success of Black or African American students as minorities, living within a democratic society (Tate, 1994). As discussed by Tate (1994), one social or political group may utilize mathematics as a tool to gain control over another. He

argued that African American students must be educated mathematically in order to participate in this struggle and advocate for their own interests. As a result, how African American students succeed in learning mathematics can directly impact how the African American community interacts with society as a whole. Such connections between learning mathematics, community, and societal factors called for a sociocultural framework for mathematical success analysis.

A Constructivist Perspective on Conceptualizing Mathematical Success

In addition to a sociocultural perspective, this study also draws from constructivist perspectives for mathematical success analysis. According to Cobb and Yackel (1995), analysis is an ongoing interaction where emphasis is placed on student interpretations and the way in which students reorganize their activity. Consistent with a constructivist perspective, I argue that each student interviewed has individually constructed his or her own conception of mathematical success based upon personal experiences that are unique to that individual. From a student's perspective, a conception of mathematical success might integrate unique constructs of mathematical success as it is conceptualized by that individual. As this study sought to explore the individual meanings of mathematical success, success factors, and relationships between and amongst them, instances of knowledge construction around mathematical experiences was likely to occur as students began to conceptualize their success. Through individual and group interviews, I hoped to capture and convey the reorganization of these personal experiences from the perspectives of the individuals who experienced them.

A Constructivist Perspective on Learning Mathematical Content

On the subject of learning mathematical content, psychological constructivist perspectives assume that students conceive mathematical concepts and that these concepts are built up or actively constructed based upon individual experiences (Von Glasserfeld, 1995). Theories from constructivism focus on what students learn and the processes by which they learn it (Cobb, 1994). Consistent with this aspect of constructivist theory, I was highly concerned with the processes by which these students learn and succeed in college-level mathematics courses. Admitting to the occurrence of individual knowledge construction as students develop mathematical understanding and/or conceptualize mathematical success, I argue that instances of knowledge construction in mathematics may also occur within social and/or cultural contexts. Drawing from both constructivist and sociocultural perspectives, I suggest that these students may have individually constructed mathematical meanings as they communicated mathematically through participation in certain social and cultural practices. These ideas are consistent with those who propose a coordination of both the constructivist and sociocultural perspectives (Cobb, 1994; Cobb & Yackel, 1995).

Although proponents of constructivism, Cobb and Yackel (1995) questioned whether a constructivist analysis adequately “captures individual student’s conceptual understanding independently of situation and purpose” (Cobb & Yackel, 1995, p. 18). I considered this also to be a problem for the goals of the current study, as I sought to understand each student’s conceptions of mathematical success and success factors within a particular context. I propose that this understanding is situated, as students are Black or African Americans attending a community college. From this position,

their goals for succeeding mathematically are directly and uniquely impacted by how they conceptualize their mathematical success within this context. For this reason, I do not feel that constructivism alone adequately provided a comprehensive framework for mathematical success analysis. I will now turn to a discussion of the emergentist perspective which adds to the conceptual framework of this study.

An Emergentist Perspective on Learning Mathematical Content

The exploration of these student's individual conceptions of sociocultural factors as they related to mathematical success was also based upon aspects of an emergentist perspective. Within this perspective, a single lens (the psychological or social) remains the backdrop for the other, reciprocity occurs between perspectives, and one is subsumed by the other (Cobb & Yackel, 1995). Like socioculturalists, emergentists subscribe to the idea that "learning and understanding are inherently social and cultural activities" (Cobb & Yackel, 1995, p. 19) although they reject the idea that social interactions are catalysts for individual, intellectual development. Participation in the activities of the community enables and constrains knowledge construction but does not determine it. Participation, however, does provide conditions for knowledge construction to occur (Krummheuer, 1992). Using this lens, social and/or cultural interactions have been described by the current study participants as situations whereby individual mathematical knowledge construction occurred. For this reason, I have drawn upon certain aspects of an emergentist perspective to help comprise the theoretical framework of this study.

According to Cobb and Yackel (1995), a social constructivist or emergentist perspective proposes a concert of both sociocultural and constructivist perspectives.

Within the framework of this study, drawing from both perspectives seemed highly appropriate as I investigated student perceptions of mathematical success, knowledge construction in mathematics, and the various sociocultural factors that they perceived to attribute to their mathematical success. Each student was provided an opportunity to individually construct his or her own definition of mathematical success while identifying and unpacking success factors that they perceived to attribute to this success. Since several of the success factors of interest for this study were perceived by the researcher to be sociocultural in nature, both social and cultural influences were likely to be present as each student drew upon individual experiences to construct his or her conception of mathematical success. Likewise, as students were to be interviewed in a focus group setting, social interactions were likely to occur which provided opportunities for students to construct conceptions of mathematical success and success factors. These assumptions are consistent with the idea that although knowledge may be viewed as individually constructed, it can also be thought to be concurrently developed through social and cultural interactions (Cobb & Yackel, 1995). Consistent with the research goals of this study, these aspects of an emergentist perspective seemed highly appropriate for interpreting mathematical success and the construction of mathematical knowledge as it develops within social and cultural contexts specific to African American students within a community college environment.

From an emergentist perspective, emphasis was also placed on individual activities as they related to each student's individual construction of mathematical success and success factors. In addition, communal activities, as described and

defined by sociocultural success factors, were also explored as activities providing conditions for individual knowledge construction to occur. During the course of conceptualizing their mathematical success and success factors, students described activities which appeared to be predominantly individualistic in nature. Although perceived to be individualistic, an emergentist view suggests that these activities are selected and enacted by students in response to a community of practice which has previously been established by the larger cultural, classroom, and/or community college environment. Those activities that students chose to engage in may differ tremendously from activities students may choose to partake in among varying communities of practice (such as four-year institutions, historically black colleges and universities, and high school settings). To further problematize this issue, the African American students in the current study are not only members of a community college community, but are also perceived members of a larger Black or African American community as a result of racial and cultural group identifications and affiliations. The characterization of an individual based on his or her community membership is highly representative of a sociocultural perspective (Cobb & Yackel, 1995) not necessarily an individualist constructivist perspective. According to Cobb and Yackel (1995), “it is precisely this sense of participation in an evolving community of practice that is typically ignored in traditional educational research” (Cobb & Yackel, 1995, p. 11). In order to begin to bridge this gap, the current study required an interpretive framework borrowing from constructivist, sociocultural, emergentist perspectives and/or a combination of such perspectives where appropriate. This allowed for an analysis which considered individual knowledge construction, each student’s

participation in a community of practice, and sociocultural factors related to each student's mathematical success.

A Concert of Constructivist and Emergentist Perspectives

A concert of both constructivist and emergentist perspectives was drawn upon as within these viewpoints, individual students are seen to construct mathematical knowledge through participation in community activities. This supports theoretical understandings portrayed by Cobb and Yackel (1995) who state that “the characterization of learning as an individual, constructive activity is therefore relativized in that these constructions are seen to occur as students participate in and contribute to practices of the local community” (Cobb & Yackel, 1995, p. 18). Within the theoretical framework of this study, this implies that the learning of mathematics at the community college level is both individual and social. Learning can be viewed as an individual, constructive activity which may also occur as students participate in and contribute to practices of the local community. The local community within this context can be viewed as the classroom community, community college community and/or the larger African American community. As this study sought to understand each student's conceptions of mathematical success and the perceived impact of sociocultural success factors, all theoretical perspectives previously discussed helped contribute to a more comprehensive framework for mathematical success analysis. An overview of the theoretical perspectives are indicated in Table 1 as follows.

Table 1: Overview of Theoretical Perspectives

	Sociocultural Theory	Constructivism	Emergentism
Theoretical Perspective/Definition	<p>Learning is viewed as an interaction between individuals and environmental contexts (Rogoff, 1995) and is underlied by social processes (Vygotsky, 1981).</p> <p>Learning occurs as a result of social and cultural activities (Cobb & Yackel, 1995).</p>	<p>Knowledge is actively constructed by the individual based upon individual experiences (Von Glasserfeld, 1995).</p>	<p>Knowledge can be individually constructed but also concurrently developed through social and cultural interactions (Cobb & Yackel, 1995). Participation in community activities provides conditions for individual knowledge construction to occur (Cobb & Yackel, 1995).</p>
Theory's influence on Research Methodology	<p>Through interviews, students may reveal social, cultural, and community factors as constructs directly impacting their mathematical success.</p>	<p>Individual interviews should provide opportunities for students to actively and individually construct a concept of mathematical success and mathematical success factors based on individual experiences. Opportunities were provided for students to describe experiences where knowledge was individually constructed.</p>	<p>Social interactions during the group interview may provide environments for students to construct a concept of mathematical success. Sociocultural contexts may be described as factors influencing knowledge construction.</p>

Definition of Terms

In order to better understand how data was collected, presented, and analyzed throughout the course of this study, several terms used throughout this dissertation are defined as follows:

1. African American (or Black) – racial category being used broadly to describe study participants who were perceived by college faculty to be Black or African American and have self-designated themselves as Black or African American as opposed to any other racial group category. In this study, Black or African American includes African American descendants of slaves as well as Caribbeans or Africans who have self-designated themselves as Black or African American.
2. Mathematically Successful – college students having completed two or more college-level mathematics courses (including Business Calculus or Calculus I), receiving a grade of B or above in all courses. This definition is consistent with mathematically successful students previously defined by D. Martin (2000) as those receiving high grades in their mathematics courses.
3. Perseverance – the demonstrated ability of participants to overcome various challenges while maintaining grades of A or B in their college math courses.
4. Sociocultural Success Factors – social, cultural, and community factors that students perceive as impacting or directly influencing their academic and/or mathematical success. These factors may include (but are not limited to) social interactions with peers and teachers, classroom discourse, cultural influences, family influences, and campus climate.

CHAPTER 2: REVIEW OF LITERATURE

This chapter begins with a discussion of factors that have been shown to impact academic achievement and persistence among African Americans in higher education, followed by a review of literature on academic achievement and success among African American community college students. Following this section is a discussion of recent research focusing on the mathematics education of African Americans in higher education. The chapter concludes with a discussion of several studies which examine mathematical success among African Americans from a sociocultural perspective. Each section concludes with information regarding how the goals of this study will contribute to the existing body of literature.

African American Academic Achievement and Persistence in Higher Education

A large portion of the literature concerning the academic achievement of African American students in higher education reveals disparities in achievement when compared to Caucasian students and other minorities (Nettles, Theony, & Gosman, 1986; Nettles, 1991). Additional research tends to focus on relative strengths (in areas such as mathematics) as demonstrated by the academic success and persistence of African Americans in institutions of higher learning (T. L. Johnson, 2001; Moody, 2004; Powell-Mikle, 2001). I begin here with a discussion of research pertaining to academic disparities between African American and Caucasian college students, and possible links to cognitive factors.

At the college level, Caucasians are seemingly outperforming African Americans (Flowers & Pascarella, 2003; Nettles et al., 1986; Nettles, 1991; Sampel &

Seymour, 1971). Reasons for this vary as described by various contributing factors to both college grade point averages (GPAs) and rates of progression.

In a national, longitudinal study by Flowers and Pascarella (2003), quantitative methodology was used to determine if cognitive differences exist between African American and Caucasian students attending four-year institutions. Objective tests were administered to students attending 18 four-year institutions to estimate the cognitive affects of race while statistically controlling for precollege and background traits, institutional characteristics, academic and social experiences. Results indicated that Caucasian students performed better than African American students on seven objective tests assessing critical thinking skills, mathematical knowledge, reading comprehension, science reasoning skills and writing skills (Flowers & Pascarella, 2003). These findings are consistent with t-test analyses conducted by Nettles (1991) based on previously collected survey data (Nettles, et al., 1986) which indicated that Caucasian students had a higher GPA and progressed through college at a much faster rate than African American students. Collectively, these results suggest that African American students continue to demonstrate significantly lower cognitive gains in college than Caucasian students.

Additional studies explored cognitive factors such as high school rank, college entrance examination scores and high school GPA as predictors of college success among both African American and Caucasian students (Breland, 1978; Nettles et al., 1986; Stanley & Porter, 1969; Thomas & Stanley, 1969). In a study conducted by Sampel and Seymour (1971), 360 undergraduate students (180 African American and 180 Caucasian) attending the University of Minnesota at Columbia, were matched on

several variables including sex and class. High school rank and scores from the Cooperative School and College Ability Test were used as predictor variables while cumulative GPA served as the dependent variable. Descriptive statistics revealed that Caucasian students significantly outperformed African American students on cumulative GPAs at the college level. These and similar results consistent with findings by Nettles et al. (1986) suggested that the achievement gap is ever-present at the college level.

Several studies illuminated differences in the strength and direction of the relationship between certain cognitive variables and college success among students of different races. A correlational analysis conducted by Nettles et al. (1986) revealed that although Scholastic Achievement Test (SAT) results and high school rank scores served as predictors for college GPAs, only a weak positive correlation was found between the variables in the case of African American male students. These results are consistent with a comprehensive review of population validity studies by Breland (1978), indicating that when identical regression equations (using traditional admittance requirements such as SAT and American College Test [ACT] results) are applied to both African American and Caucasian students, college performance tends to be over predicted for African American students. Likewise, quantitative analyses of survey data by Nettles (1991) revealed that high composite SAT scores contributed greatly to the academic progression of Caucasian students but not African American college students. In addition, interfering problems were more strongly correlated with both African American and Caucasian students' college GPAs than SAT scores. In studies of this nature, the inability of cognitive factors

such as SAT scores, to accurately predict academic success and persistence among African American college students is apparent. Nettles et al. (1986) discussed additional limitations of these studies including inconsistency of GPA calculations and academic standards within and across institutions. High attrition and variation among entrance requirements can also cause problems with the generalizability of these results. These, among other limitations, have prompted researchers to consider additional non-cognitive and environmental factors as predictors of academic achievement and persistence at the college level.

Nettles et al. (1986) further examined how the different college experiences of African American and Caucasian students affected college performance. Nettles et al. (1986) explored the predictive validity of a variety of variables including academic integration, feelings that the university is nondiscriminatory, student satisfaction, peer group relations, interfering problems, study habits, socioeconomic status, and faculty attitudes and behaviors. Among the independent student variables were SAT scores, race, sex, age, high school GPA, marital status, and number of hours spent working while attending college. The two institutional characteristics included as independent variables were the predominant race of the institution and total enrollment. A quantitative analysis of data collected from 30 United States (U.S.) colleges and universities revealed that African American students and Caucasian students differed significantly (at the .001 level) on their college experiences (Nettles et al., 1986). Specifically, African American students were shown to have significantly lower academic integration, were less likely to feel their institution was nondiscriminatory, were less satisfied with their institution, and had more interfering problems than

Caucasian college students. Caucasian students were also shown to progress through college at a much faster rate than African American students (Nettles et al., 1986). These results suggest that several non-cognitive factors may have differential effects on the academic success of Caucasian and African American college students respectively. The empirical evidence discussed here speaks to a need for researchers to explore the possibility that non-cognitive factors may significantly impact academic achievement and success at the college level, and that these factors may affect Caucasian and African American students differently.

Additional reasons for differences in achievement and persistence were revealed through Nettles' (1991) t-test analyses indicating that Caucasian students had higher high school grades and SAT scores, had higher socioeconomic statuses, and showed a greater commitment to their institutions than their African American counterparts. These factors positively impacted Caucasian students' college progression. For African American students, the t-test analyses revealed significantly greater financial need, lower SAT scores, and lower high school GPAs which negatively impacted college performance and progression. Collectively, these results suggest the effects of differential cognitive and non-cognitive factors as possible explanations for low academic achievement and persistence among African Americans students when compared to Caucasians.

Although several studies illuminated disparities in achievement when examining African American students at the college level (Flowers & Pascarella, 2003; Nettles et al., 1986; Nettles, 1991; Sampel & Seymour, 1971), others have chosen to examine academic achievement, persistence, and gains among this

population (Desousa & Kuh, 1996; Fries-Britt, 1998; T.L. Johnson, 2001; Powell-Mikle, 2001). A quantitative study conducted by Himelhoch, Nichols, Ball, and Black (1997) examined persistence factors among African American students attending historically Black colleges and universities (HBCU's) and compared them to those attending predominantly White institutions (PWI's). Bean's (1982) synthetic model of student attrition was used as a guiding framework to examine factors that predict persistence among this group of students. The overall purpose of the study was to ascertain the differences between persistence factors for African American students attending HBCU's and those attending PWI's. Himelhoch et al. (1997) hypothesized that Bean's (1982) model was not comprehensive enough to explain persistence factors among African American students and moreover, the differences in persistence factors between those attending HBCU's and those attending PWI's. To examine these issues, a stratified sample was collected comprised of 3,922 freshmen students. Within this sample, 295 were African American. Of the 295 students, 78 attended a PWI while 217 attended an HBCU. All institutions attended were four-year institutions. The data used was compiled by the Cooperative Institutional Research Program database at the University of California-Los Angeles. Variables from this database which corresponded with variables from Bean's (1982) model were analyzed. Factor analyses were used to construct scaled variables. These variables were later used for a regression analysis which identified both general predictors of persistence for all students as well as predictors for African American students attending HBCU's and PWI's. While several predictors were revealed for the general student population, faculty mentoring was the only significant variable related

to the persistence of African American students at a PWI. Moreover, faculty mentoring explained 19% of the variance in persistence, which was the highest amount of variance explained among all regression equations used. For African American students attending HBCU's, among several significant variables that were positively associated with persistence were faculty mentoring and changes in majors or careers. For example, changes in majors or careers were positively associated with persistence as some students may have viewed higher education as necessary for achieving success in their new choice of career. Based on these results, Himelhoch et al. (1997) recommends lowering teaching loads for faculty to encourage faculty mentoring which may increase rates of persistence among African American students attending both types of institutions.

Desousa and Kuh (1996) compared the academic gains of African American students involved in campus activities at HBCU's with those of African American students involved in similar activities at PWI's. A College Student Experiences Questionnaire was distributed and administered to a sample of 1200 African American students attending an HBCU and PWI in the mid-Atlantic region of the US. Results from an Analysis of Variance test revealed that African American students attending the HBCU reported greater educational gains, were more engaged in academic activities, devoted more time to academics, and perceived greater educational benefits than those attending the PWI (Desousa & Kuh, 1996). These findings are consistent with regression analyses revealing that both African American and Caucasian students progressed more quickly through college when they were in the racial majority at their institution (Nettles, 1991). Collectively, these results

suggest a need to examine the collegiate experiences of African American students attending institutions where they are considered to be both the racial majority and the racial minority. Studies which consider the effects of the racial composition of the institution on the collegiate experiences of students may provide empirical evidence demonstrating differential collegiate experiences for African American and Caucasian students in different collegiate environments. Studies using only quantitative methodology may sometimes provide limited information regarding student perceptions of their academic environments and the various experiences they have within these environments. Along these lines, several studies were reviewed which incorporated qualitative methodology to further explore this topic.

A multi-method study conducted by Jackson (1996) examined the experiences of African American women on two PWI and two HBCU campuses across the US. Of the four campuses, two were women's colleges and two were coeducational. The sample size for the quantitative measures consisted of 135 women in their sophomore and junior years. All data was collected during the 1995-1996 school year. The students completed a battery of questionnaires including a demographic questionnaire, the Multiethnic Identity Measure (MEIM) by Phinney (1992), a modified form of the Twenty Statements Test (TST) by Kuhn and McPartland (1954), and a gender identity measure (GIM). From three of the four schools, a subsample of 20 women participated in individual interviews with the researcher to provide additional data for qualitative analysis.

Quantitative results from the TST measures revealed that a majority of the participants identified both race and gender as constructs which were related, highly

important, and influential to their self-concepts. This relationship “manifests itself through both race and gender in their self-concepts” (Jackson, 1996, p. 364).

Although not as significant, MEIM results suggested that ethnic identity was high across all schools and did not vary significantly. This suggested that ethnic identity was not influenced greatly by the racial and/or gender composition of the institution although additional qualitative results suggested that “the racial and gender composition of schools strongly influences the options available for these women to experience both their gender and racial identity” (Jackson, 1996, pp. 370).

Littleton (2001) examined the college experiences of 24 African American students persisting towards graduation at several small PWI’s located in the Southeastern part of the US. This qualitative study used semi-structured interviews to collect data for the purpose of providing faculty and administrators with tools to improve the academic experiences, rates of persistence and graduation rates among their African American students. Students selected for the study had matriculated to their junior or senior year at liberal arts colleges located in the Appalachian region of the country.

Results indicated that one factor that all participants attributed to their ability to persist at the college level was the positive influence of college faculty (Littleton, 2001). More specifically, several students mentioned positive characteristics of faculty such as their ability to convey high expectations and offer tough love when needed. Both caring faculty and administrators were found to greatly impact these students in a positive way. This influence was significant and seemingly contributed to their ability to persist. In addition, the African American students seemed to share

characteristics of determination and persistence, which greatly improved their success in college. The small, predominantly White college environment was also extremely relevant to these students ability to persist. The students saw the small environment of the liberal arts college as supportive, allowing them to focus more on their studies and less on partying. In addition, the small college environment provided additional opportunities for individualized attention which lead to greater academic success for the students. Lastly, positive family influences were found to be the third persistence factor most reported among all participants. This seemed to be related to the need for an African American role model for students, which was also significant among persisters. It should also be noted that across all participating institutions, students mentioned disappointment with the number of African American faculty at the institution. This seemed to be a major concern among students as they wished for someone among the faculty that they could relate to. Littleton (2001) recommended that future research explore the relationships between family influences and student persistence. He also argued for researchers to design studies which will specifically look for ways to meet the needs of African American female students. He recommended that these institutions work to increase the number of African American faculty and administrators to begin to address this need.

African American Academic Achievement and Persistence in Community Colleges

As the current study sought to explore mathematical success among African American community college students, a discussion of previous research concerning this population of students is appropriate. Although a majority of the studies concerning academic achievement among African Americans in college focus on

four-year institutions, several researchers have recently begun to explore success and failure among minority and/or African American students at the community college level. Green's (2003) quantitative study examined the degree to which specific cultural factors and learning experiences predicted the persistence rates of African American students attending a large, urban, community college in Michigan. During the fall semesters of 2001 and 2002, a survey was distributed to 399 African American students to solicit information regarding student experiences and the cultural factors which may have contributed to their decision to persist at the institution. The predictor variables used for the study were academic standing, personal status, students' perceptions of faculty-student interaction, self-efficacy, and cultural factors. Cultural factors included church, ethnic identification, biculturalism, extended family, oral traditions, shared knowledge communication behaviors, and representation as it relates to being perceived by others as a speaker for the entire race. The dependent or criterion variables were persistence and self-efficacy. Although the predictability of persistence was not statistically significant for any of these variables, descriptive results revealed that oral traditions, shared knowledge, and the ability to share their thoughts and ideas freely were important factors in students' decisions to persist (Green, 2003). Inconsistent with feelings of isolation, as experienced by other high-achieving African American college students (Fries-Britt, 1998), most of the students surveyed by Green (2003) did not report feeling isolated from other African Americans nor did they report feeling that they had experienced stereotypical behaviors towards them based on their race. Persisting students felt more positively about their ability to accomplish their academic goals, and were more

likely to have higher cumulative GPAs than students who did not remain at the institution. In other words, students who were experiencing success were more likely to persist (Green, 2003).

Several studies examining African American students attending community colleges focused exclusively on female (T.L. Johnson, 2001) or male (Bush, 2004) students. T.L. Johnson (2001) examined the success strategies of ten, African American women attending a community college in Seattle, Washington. Using qualitative data collected from individual and focus group interviews, T.L. Johnson's (2001) study reported survival strategies for academic success that included family support, spirituality, taking individual responsibility for one's own success, institutional support, having relevant career and academic goals, support and encouragement from friends, and being motivated by a need to meet financial obligations and investments. The identification of several social factors such as family and peer support as well as cultural factors such as spirituality, suggested a direct link between academic persistence and various sociocultural factors.

Bush's (2004) study examined the impact of a variety of factors on the academic achievement of African American males attending a community college. Bush (2004) utilized quantitative methodology with elements of case study research to determine if a relationship existed between various institutional factors and academic achievement among African American males attending a California state community college. The study considered peer and faculty interactions, campus climate, and student involvement as institutional factors that directly impact the academic achievement of this population. Results from survey and interview data

indicated that African American males had the lowest level of academic achievement in terms of degree attainment, GPA, and persistence rate when compared to other ethnic/gender groups (primarily Caucasians) within the community college setting (Bush, 2004). These results are consistent with findings from others (Flowers & Pascarella, 2003; Nettles et al., 1986; Nettles, 1991 Sampel & Seymour, 1971) which illuminated academic disparities between Caucasian and African American students in college.

Correlational and multiple regression analyses revealed that social interactions between peers was significantly related to GPAs, transfer rates, and degree or certification attainment among African American male students (Bush, 2004). In some cases, these social interactions had a negative impact on the students' overall academic achievement. In the cases where interactions with peers were perceived as negative, students had to overcome these negative influences from peers in order to succeed academically. Such negative peer consequences for African American males are reminiscent of negative peer experiences among other high-achieving African American middle (D. Martin, 2000) and college (Fries-Britt, 1998) students who are often forced into isolation as a consequence of academic success.

Overall campus climate strongly predicted transfer rates, GPAs, and graduation rates among the African American males (Bush, 2004). Although student involvement did not predict any of the outcome measures, parent education predicted GPA and degree aspiration as well as rate of persistence. These demonstrated relationships between non-cognitive variables and academic success and persistence among African American males, suggested the sizable impact that non-cognitive and

institutional variables may have on the college experiences and academic success of African Americans. The current study contributes to the literature in this area as it provided opportunities for students to identify non-cognitive factors that they perceived to directly impact their mathematical success at the college level. This approach differs from Bush's (2004) study in that both male and female students were interviewed, factors were not predetermined, and factors were based on individual student experiences.

Within the community college literature, several studies have examined the impact of positive and negative interactions with college faculty on academic success and persistence (Green, 2003; Bush, 2004). Results from Green's (2003) study suggested a positive relationship between African American students' decision to persist and student-faculty relationships. For example, students who reported experiencing positive relationships with faculty were more likely to believe in their ability to meet their academic goals. Likewise, Bush (2004) discovered through quantitative analyses that faculty interactions was the strongest predictor of persistence among African American males when considered with other institutional variables: campus involvement, peer interaction, and campus climate. This was evidenced as positive student-faculty interactions resulted in higher retention rates, increased likelihood to transfer to a four-year institution, and additional points towards GPAs. Negative student-faculty interactions also seemed to have an impact on academic success. African American males, who were less likely to interact with faculty, demonstrated lower academic achievement when compared to Caucasian students as evidenced by lower GPAs (Bush, 2004). These and similar results

provide empirical evidence in support of future research seeking to examine the influence of non-cognitive and institutional factors (such as social interactions) on the academic success of African American students at the community college level.

The Mathematics Education of African American Students in Higher Education

Although a considerable amount of research in higher education followed a deficit approach, several studies examined African American students' academic strengths at the college level. Powell-Mikle's (2001) qualitative study utilizes interviews, teacher observations, surveys, and student autobiographies to better understand mathematically successful African American students' perceptions of their mathematics education and their social interactions with peers and faculty. All participating students attended a four-year, southern, PWI and had successfully completed a three course calculus series. Consistent with findings from others (Flowers & Pascarella, 2003; Fries-Britt, 1998; Green, 2003; D. Martin, 2000), qualitative data analyses revealed that academically successful students had positive interactions with peers and teachers which contributed to their success. In addition, high-achieving students indicated that they had positive feelings towards their mathematics education. This was especially true if mathematical skills and reasoning could be connected to experiences in their everyday lives (Powell-Mikle, 2001). This finding supports the need for African American students to recognize the relevance and utility of mathematical knowledge as proposed by D. Martin (2000) and Tate (1994). Lastly, mathematically successful students were able to persist in the study of mathematics despite difficulties experienced along the way. This suggests that the students were committed, hard working, and able to persevere (Powell-Mikle, 2001).

Students' level of effort was also a factor in Treisman's (1985) study examining the mathematical performance of African American students in first-year calculus. The purpose of the study was to determine what factors explained performance differences between African American and Chinese American students. Typically, the Chinese American students outperformed the African Americans in the course. Using mostly ethnographic methodology, 20 African American and 20 Chinese American calculus students were interviewed frequently throughout the 1975-1976 school year at the University of California at Berkley. Informal methods were used to observe students as they prepared homework assignments and studied for tests and quizzes. The most significant finding revealed differential methods employed by African American and Chinese students while completing homework assignments and preparing for exams. African American students tended to study alone whereas Chinese American students often worked together in peer study groups; sharing mathematical understanding, assisting each other with difficult problems, checking their work, and taking difficult problems to the teaching assistant (Fullilove & Treisman, 1990; Treisman, 1985). Increased effort was also a major factor as Chinese American students studied an average of 6 hours per week more than African American students. In contrast, African American students rarely worked together, studied less, and rarely took difficult problems to the teaching assistant. Instead, African American students reviewed their own solutions or consulted similar problems within their text (Treisman, 1985). Notably, Treisman's (1985) study revealed that African American students seemed to approach the learning of mathematical content differently than Chinese American students. These

and similar findings led to the development of a highly successful, organized program of peer study and small group interaction for minority students (mostly African American and Hispanic) taking first-year calculus at the University of California at Berkeley (Fullilove & Treisman, 1990).

Designed as an honors program, The Mathematics Workshop Program (MWP) recruited high-achieving minority students with an interest in mathematical careers (Fullilove & Treisman, 1990). As a part of the program, students had to attend two-hour workshops weekly. During the workshops, students were encouraged to work on mathematics problems in assigned groups. Modeled after the successful Chinese American students in Treisman's (1985) study, students were encouraged to help each other solve difficult problems while sharing solution strategies with peers. Each group had a graduate student leader that assessed whether or not the students understood the concepts and provided subtle hints and feedback for students when appropriate.

Incorporating data collected from successful minority students prior to the implementation of the program, a chi-square analysis revealed a significant difference between failure rates of students who participated in the program and those who did not (Fullilove & Treisman, 1990). Overall, students in the program were two to three times more likely to earn a grade of B- or better in the calculus course than minority students who were not enrolled in the program. These findings held even for workshop students who had lower SAT mathematics scores than the non-workshop students. In other words, program participation correlated more strongly with mathematical success than SAT mathematics scores. Consistent with similar findings

(Bonsangue, 1992; Breland, 1978; Nettles et al., 1986; Nettles, 1991) these results suggest that SAT mathematics scores may not be the best way to predict mathematical success at the college level.

Reasons for mathematical success among workshop students were hypothesized as more time on mathematical tasks (provided through the workshops) and the development of social skills through workshop peer groups (Fullilove & Treisman, 1990). The organized structure of the peer workshops seemed to provide an environment for students to interact and connect with other high-achieving minority students while improving the possibility of mathematical and academic success. The empirical evidence provided suggests the importance of examining organized peer interactions in relation to mathematical success among African American students.

Bonsangue (1992) used both qualitative and quantitative methodology to evaluate the academic achievement, persistence, social, and academic integration effects of a similar calculus workshop at California State Polytechnic University (Poly). Modeled after the Treisman (1985) program, The Academic Excellence Workshop program targeted minority students interested in the sciences and engineering fields. The program provided orientations, peer counseling, tutoring, and increased social interaction and community building. Effects of the program were examined during first quarter calculus and subsequent major mathematics courses.

Workshop students met biweekly in groups of 10-12 students for two-hour sessions where students were encouraged to work in groups on challenging (but not frustrating) mathematical problems that were carefully selected (Bonsangue, 1992). Similar to the Treisman (1985) workgroups, each group was facilitated by an

undergraduate student (a former workshop participant) who seldom answered direct questions, but encouraged students to work together to solve problems. Facilitators reached out to students who were not attending workshops and/or classes regularly, and assisted with getting them back on track. The nature of these student interactions with older group facilitators is similar to the influence of near-peers (such as older students or siblings) previously shown to increase mathematical success among African American students as discussed by D. Martin (2000).

Bosangue's (1992) longitudinal study tracking six cohorts of workshop and non-workshop students began during the 1990/1991 school year. Drawing questions from Pascarella's (1982) survey, data was collected using a Student Involvement Questionnaire (SIQ). In addition, several personal interviews were conducted three to four years after initial program participation. Dependent variables included best quarter grades received in each mathematics course and the number of enrollments in each course. To examine persistence rates, Bonsangue (1992) looked at the number of credit units earned, overall GPA, class standing, number of units completed within each major, GPAs based on major courses, completion or non-completion of the mathematics requirement for each student's major, whether or not the student was still enrolled in a mathematics-based major, and whether or not the student was still enrolled at the institution.

No significant differences between workshop and non-workshop students were found in regards to pre-college measurements of ability and achievement (Bosangue, 1992). Bonsangue (1992) hypothesized that the self-selectivity of the workshop students who chose to participate in the program tended to be indicative of

their desire to succeed academically, not necessarily indicative of high levels of ability. The only significant predictor of course grades was found to be the number of hours students invested in coursework. This supports Treisman's (1985, 1992) findings that Chinese American calculus students who outperformed African American students spent more time on mathematics coursework. Similarly, these results support Astin's (1964) Theory of Involvement suggesting that students investing greater amounts of time within their discipline have a greater chance for academic success than those who do not.

Observed differences in achievement and persistence among workshop and non-workshop students also suggested a link between social involvement and achievement among minority college students (Bonsangue, 1992). This idea is consistent with the relationship between social involvement at the institution and academic success and degree completion as discussed by Pascarella (1985). Collectively, these and similar results support the contention that organized peer study can be highly effective for students when attendance is required, there is a focused goal, active participation is involved, and studying occurs within the context of the academic discipline or department (Fullilove & Treisman, 1990; Treisman, 1985).

Organized peer study in workshop programs also may have positively impacted students' relationships with teachers, overall contributing to their mathematical success. According to Bonsangue (1992), workshop students described greater involvement in interactions with faculty and advisors than non-workshop students as demonstrated through SIQ survey results. This is consistent with Tinto's

(1987) Theory of Student Departure identifying social and academic experiences at the institution and personal integration as causal events affecting college departure decisions. The increased informal contact with professors through workshop participation (occasionally, calculus professors would visit workshop sessions) may have increased the likelihood that students would remain at the institution (Bonsangue, 1992).

Overall, the students who participated in the workshops had higher grades in calculus, lower course attempt ratios, greater persistence in calculus, and greater persistence in their mathematics-related major or program of study (Bonsangue, 1992). When considering the fact that there were not significant differences between workshop and non-workshop students on pre-college variables, these results support the sizable impact that sociocultural factors may have on the academic success of minority students.

To further examine various socio-cultural factors and their impact on the mathematical success of high-achieving African American college students, Ellington (2006) employed interpretive case study methodology to examine the experiences of African American math majors. Using individual, semi-structured interviews, Ellington (2006) sought to understand how eight students perceived various experiences throughout their mathematics education to impact their mathematical success at the college level. Particular attention was given to how these students succeeded and persisted despite various challenges. Types of experiences examined included personal, social, and cultural.

Due to the difficulty encountered when trying to find high-achieving, African American math majors, Ellington (2006) interviewed participants from several four-year institutions (two PWI's and one HBCU) in Maryland. All participants selected were born in the US and received their pre-college education there. Each student was either a junior or senior math major with a GPA of 3.0 or higher. All students had taken or were currently taking mathematics courses above the calculus level. During the spring semester of 2005, two individual interviews were conducted with each student.

Ellington (2006) found that these math majors liked mathematics as a discipline or had a positive attitude towards mathematics. This played a major role in their decision to become a math major and persist within the study of the discipline. In addition, parents, teachers, and peers provided these students with encouragement which led to their success. Parents were supportive, caring, encouraging and engaged in their children's education throughout their mathematical experiences. This often included mothers advocating for the child's education and fathers cultivating in them an early interest in mathematics. Participants were also motivated by a spiritual and/or social consciousness instilled in them by their parents. This fostered a desire to succeed mathematically as well as a responsibility to God and the larger African American community. Collectively, these parents instilled in their children the value of education, hard work, discipline, and giving back to their communities.

For the participants in Ellington's (2006) study, mothers advocating for their children's education often resulted in students being placed in Talented and Gifted programs with advanced coursework. "Once these students were placed in these

gifted and talented tracks in elementary school, these caring teachers exposed them to challenging and engaging mathematics coursework, activities and competitions that cultivated their interest in the subject” (Ellington, 2006, p. 112). In addition, many of these students benefited socially from interacting with like-minded peers who were also high-achieving. These peers held high expectations for the students while providing both academic and social support throughout high school and college.

Such social and academic benefits of peer and faculty interactions may have greatly contributed to improved mathematical performance and persistence among African American students studying mathematics at the college level. Results indicated by Ellington (2006), Bonsangue (1992), and Treisman (1985) provide support for future research exploring the possible relationship between sociocultural factors and mathematical success among minority college students. Such a purpose was a primary goal of the current study.

Sociocultural Factors and Mathematical Success among African American Students

A review of literature on the topic of the mathematical success of African American students in high school and college-level mathematics courses has revealed several sociocultural factors which seemingly contribute to their success. Positive peer interactions and student-faculty interactions appear to contribute significantly to the mathematical and general academic success of this population of students (Bonsangue, 1992; Fries-Britt, 1998; Gutierrez, 2000; Moody, 2004; Powell-Mikle, 2001; Treisman, 1985; Treisman, 1992). Likewise, most students who were

successful in the study of advanced mathematics, seemingly matriculated through rigorous high school mathematics programs (Gutierrez, 2000; Moody, 2004; Powell-Mikle, 2001; Thompson & Lewis, 2005) and demonstrated a strong sense of persistence and individual effort (Bonsangue, 1992; Fullilove & Treisman, 1990; Mooney & Thornton, 1999; Powell-Mikle, 2001; Thompson & Lewis, 2005; Treisman, 1985). As individuals, mathematically successful students also seemed to maintain positive mathematics identities and self-identities as learners of mathematics (Hackett & Betz, 1989; D. Martin, 2000; Moody, 2004; Thompson & Lewis, 2005). These identities can be informed through social interactions with others such as teachers and peers. Likewise, positive racial identities have also been previously linked with academic (Boykin, 1986; Fordham, 1988; Fries-Britt, 1998; Ogbu, 1986; Prager, 1982) and mathematical success (D. Martin, 2000; Moody, 2004) among African American students. These identities may also be informed through social interactions including racialized experiences. Consistent with the value of relevant mathematics curricula and pedagogy as discussed by Tate (1994) and D. Martin (2000), Gutierrez (2000) found that African American math students at the secondary level performed better when mathematics pedagogy and curricula were culturally relevant and well-adapted to their needs. Examples of the influence of such sociocultural factors on the mathematical performance and success of African American students is also revealed in Strutchens' (1993) study examining the mathematical performance of sixth grade African American students.

Strutchens (1993) used natural inquiry to examine the interactions between five African American sixth graders and their parents, teacher, and peers. The

students varied in mathematical performance and were recommended by their teacher for participation in the study. A case study method was used as Strutchens (1993) observed the students in their mathematics classrooms, administered a survey, and conducted interviews with the students, parents, and teacher. The purpose of the study was to determine what ethnic and societal factors affected the students' mathematics performance in the classroom. Among the findings, Strutchens (1993) found that a majority of the students liked mathematics, saw mathematics as relevant and necessary, believed that math performance and success was a direct result of individual effort, were sometimes highly influenced (both positively and negatively) by their peers, had parents who valued education, and appeared to meet the expectations of their teacher (whether such expectations were high or low). Strutchens (1993) concluded that the most important factors impacting mathematical performance among African American students were students' perceptions and expectations in the classroom. In addition, Strutchens (1993) proposed that there were a variety of additional influences including parental, peer, community, school, student and teacher influences that impacted these students' perceptions and expectations. As a result, these influences directly impacted their mathematical performance later in the classroom. As recent research continues to connect these and other sociocultural factors with the mathematical success of African Americans, it is necessary to explore literature that further examines the nature of such connections.

Brand, Glasson, and Green (2006) found various sociocultural factors to impact African American students' participation in math and science classes at the high school level. Using qualitative methodology and a sociocultural framework of

analysis, Brand et al. (2006) examined the various sociocultural factors affecting the performance of high-achieving African Americans in a college preparatory program for future teachers. Interviews were used to explore five students' perspectives and reflections surrounding their experiences in advanced science and mathematics classrooms. The overall purpose of the study was to further examine sociocultural contexts to gain a deeper understanding of the factors prohibiting African Americans from high achievement and participation in these courses (Brand, et al., 2006).

Student responses to interview questions revealed two major themes regarding sociocultural influences affecting their participation: (a) the impact of negative racial stereotypes on students' learning and participation and (b) the positive impact of student-teacher relationships on learning and participation in math and science (Brand et al., 2006).

Disenfranchising stereotypes have portrayed math and science as subjects for "smart" people who are generally not depicted as minority students (Brand et al., 2006). In response, these students must struggle to disassociate themselves from such stereotypes while preventing them from impacting their self-esteem. Simultaneously, minority students are often discouraged from pursuing careers in math and science fields (Brand et al., 2006). As this began to play out within student-teacher relationships, the participants in Brand et al.'s (2006) study took on defensive stances in response to negative perceptions of their teachers' beliefs. In addition, the negative nature of these relationships was perceived by the students to negatively impact their academic performance. Contrastingly, these researchers found positive student-teacher "relationships could convey to students messages of acceptance and

confidence in their abilities and can be interpreted by them as the teacher not holding society's negative views" (Brand et al., 2006, p. 236). This can lead to increased academic performance and success among minority students. As a result, Brand et al. (2006) calls for teachers to become critically aware of their beliefs and how they may negatively define the learning environment for African American students in math and science classrooms.

Mathematics Identities and Self-Identities as Learners of Mathematics

Several scholars have examined self-concept, self-identity, and mathematical identity as it relates to mathematical achievement, performance, and attitudes towards mathematics (Hackett, 1985; Hackett and Betz, 1989; D. Martin, 2000). Previous literature reviewed suggests varying views on these constructs as they are constructed by the individual or socially constructed through negotiation with others (Bruner, 1990). Still others argue that these constructs are a result of an interaction of both (Wenger, 1998) as individual knowledge is continuously influenced, modified, and expanded through social negotiations with others. Abrue and Cline (2003) suggested two sources of self-identification associated with mathematical practice; incorporating how others are identified and how students are identified by others through mathematical practice. In these ways, self-identity construction can be linked to social, cultural, historical, and individual factors. It is this interpretation of self-identity or mathematics identity that I suggest most adequately describes the identity construct as it relates to mathematical success within a sociocultural framework.

Across several studies reviewed, mathematically successful African American students appeared to have positive self-identities as learners of mathematics and/or

positive mathematics identities (D. Martin, 2000; Moody, 2004; Thompson & Lewis, 2005). In other words, successful African American students viewed themselves as academically capable of doing mathematics. One's attitude towards the discipline of mathematics and his or her ability to succeed mathematically has previously been defined by Hackett and Betz (1989) as a person's mathematics self-efficacy. Various studies described levels of mathematics self-efficacy as important predictors of future mathematics performance and achievement (Hackett, 1985; Hackett & Betz, 1989). Further examination of the relationship between mathematics achievement and mathematical self-efficacy can greatly contribute to understanding how African Americans perceive themselves as learners of mathematics and how these self-perceptions might impact their success. For example, according to Hackett and Betz (1989), "mathematics self-efficacy can be distinguished from other measures of attitudes towards mathematics in that mathematics self-efficacy is a situational or problem-specific assessment of an individual's confidence in her or his ability to successfully perform or accomplish a particular task or problem" (Hackett & Betz, 1989, p. 262). This description of self-efficacy as situational implies how various contextual and/or cultural factors might be linked to mathematics self-efficacy, mathematics identity, and subsequently, mathematics achievement and persistence. According to D. Martin (2000), one's mathematics identity strongly parallels one's racial identity. I propose that these various identities are connected within a sociocultural framework. Among others, these constructs interact consistently to impact the mathematical success of the African American student.

*Racial Identities and the Impact of Community and Culture on the Mathematics
Education of African American Students*

Throughout the literature, aspects of a positive racial identity was found consistently among academically successful African American students (Boykin, 1986; Fordham, 1988; Fries-Britt, 1998; D. Martin, 2000; Moody, 2004; Ogbu, 1986; Prager, 1982). However, maintaining a positive racial identity becomes increasingly difficult for these high-achieving students as they constantly struggled to maintain kinship with other African American students within their environment (Fordham, 1988). Fries-Britt (1998) described black-achiever isolation as that which develops as a result of the social difficulties faced by successful African American college students as they struggle to maintain social relationships with both African American and Caucasian students. Likewise, Boykin (1986) and Prager (1982) discussed the ensuing struggle of the African American who must navigate both the dominant (Caucasian) and African American cultural systems within academic environments. This experience has been described as bicultural since both cultures appear to behave differently in academic situations (Prager, 1982). As a result, a student's inability to navigate successfully between both cultural systems can greatly impact academic and social success, leading to negative racial and academic experiences (Fries-Britt, 1998).

According to Moody (2004), it is important to conceptualize "how African American students view their success with school mathematics, namely, whether they perceive their becoming successful with school mathematics as having particular consequences, or if they perceive their becoming successful as consistent with their

own cultural or social identities” (Moody, 2004, p.137). For example, cultural inversion as described by Ogbu (1986) is a tendency for African American students to avoid certain academic behaviors that they view as legitimate or culturally acceptable for Caucasians only. Unfortunately, many African American students continue to believe that only Caucasian males can be successful in mathematics (Brand et al., 2006; M.L. Johnson, 1984; Powell-Mikle, 2000) contributing to negative racial identities and low mathematical success among African American students.

Previous research has documented the impact of negative racial experiences on the educational attainment of African American students (Fries-Britt, 1998; D. Martin, 2000; Moody, 2004). In some cases, these experiences have been known to negatively affect a student’s perception of their own racial identity (D. Martin, 2000). In other cases, African American students have been known to use these negative experiences as motivational factors, helping them to achieve greater academic success (D. Martin, 2000). Such negative experiences can involve racism in the form of low expectations from teachers and ill-treatment from African American peers for “acting white” (Fries-Britt, 1998; Moody, 2004). In D. Martin’s (2000) study, African American middle school students characterized these racialized experiences as motivational. They expressed a need to excel academically because of their racial affiliation and their role model status within their racial group. Purposeful academic success appeared to be a response to poor treatment and low expectations based on racial group affiliations.

In other instances however, African American students responded both positively and negatively to racial experiences related to mathematical participation.

For example, an African American graduate student expressed both anger and joy at being the only African American enrolled in an advanced mathematics course (Moody, 2004). Similarly, both negative and positive responses to racism were described by African American parents in D. Martin's (2000) study. In some cases, negative experiences invoked a sense of agency on behalf of the participants leading to increased motivation to study and additional value being placed on the discipline of mathematics. For others, a diminished value was placed on mathematical knowledge as a result of such experiences.

Whether positive or negative, all racial experiences seemed to influence each student's perception of themselves as an African American student of mathematics. This racial identity seemingly affected their personal academic success and sometimes, the subsequent success of future generations (D. Martin, 2000). For these reasons, it is imperative that mathematics teachers of African American students provide supportive learning environments that convey attitudes of eminent accomplishment and success for students of all races.

The Role of Social Interactions and Communication in Conceptualizing Mathematical Success Among African Americans

When analyzing the success of African American students from a sociocultural perspective, the cultural aspects of communication can become tools for analysis as we begin to examine how African American students communicate with each other, their teachers, their institutions, and the larger community. Ideally, discourse within the mathematics classroom community illuminates students' mathematical understandings. Drawing from, socioicultural, constructivist, and

emergentist perspectives, I argue that students construct mathematical meaning as they communicate mathematically with each others and with their teachers through participation in certain cultural practices (Cobb, 1994; Cobb & Yackel, 1995). From a sociocultural perspective, these individuals learn mathematics as they communicate their ideas mathematically, while sharing these ideas with others (Vygotsky, 1994). Vygotsky (1994) suggested that mathematical understanding stems from an individual's ability to connect prior knowledge with new mathematical language within a social context. The act of communication can facilitate this process as students share mathematical meanings and understandings with other members of the classroom community (Cobb & Yackel, 1995; National Council of Teachers of Mathematics, 2000). In the case of the African American student, I argue that such communication may occur most easily within a mathematics classroom where individual culture is valued and affirmed and students can feel comfortable communicating mathematically.

The Role of Peers in Mathematics Socialization

According to Powell-Mikle (2001), many academically successful African American students attributed their success to positive peer interactions with other students and group study. Likewise, D. Martin (2000) found that successful African American students tended to form social and academic relationships with other successful African American students. Similarly, Ladson-Billings (1995) found that successful teachers of African American students supported peer interactions in the classroom as they “encouraged students to learn collaboratively, teach each other, and be responsible for the academic success of others” (Ladson-Billings, 1995, p. 481).

This form of collaboration among peers can promote a community of learners in which minimal emphasis is placed on the success of the individual student but is instead focused on the larger mathematical community. The nature of the individual student's success then becomes impacted by the mathematical success of the larger learning community. This community success may extend outside of the classroom environment, as high-achieving, African American students may support academic success among non-classmates through mutual encouragement and friendly academic competition (D. Martin, 2000). Through a sociocultural lens, the individual success of the African American student is not entirely independent of peer and community success.

As reviewed in the literature, the nature of social interactions among African American students and their peers can greatly impact their academic success both positively and negatively (Fries-Britt, 1998; D. Martin, 2000; Powell-Mikle, 2001). At the college level, study groups among high-achieving, African American students have been shown to contribute to mathematical success as students are able to work collaboratively to understand difficult mathematical content (Bonsangue, 1982; Fries-Britt, 1998; Fullilove & Treisman, 1990; Treisman, 1985; Treisman, 1992). The nature of these peer interactions and how they connect to mathematical success suggests a relationship between individual mathematical success and social interactions with peers. A sociocultural perspective for mathematical success analysis can illuminate these connections, leading to a deeper understanding of mathematical success among African American students.

Student-faculty Interactions and the Influences of Culture, Society, and Race

Among the most significant cultural interactions within a classroom environment are the messages conveyed between students and their teachers. D. Martin (2000) described mathematics teachers as “primary agents of mathematics socialization within the school context” (D. Martin, 2000, p. 91). According to D. Martin (2000), the messages that these teachers convey to African American students about mathematics and their ability to do mathematics can “form an integral part of the mathematics socialization process that African American students undergo in school and classroom contexts.” (D. Martin, 2000, p. 14). This idea is consistent with the equity principle expressed in the National Council of Teachers of Mathematics (NCTM) standards which promotes the communication of high expectations from teachers to all students (NCTM, 2000). In the case of the African American student, these messages can support or suspend mathematical progress and academic success. For example, one African American parent’s negative experiences with a teacher contributed to her negative mathematics identity and subsequent low academic expectations for her own children (D. Martin, 2000). In addition, other parents discussed low expectations of mostly White teachers, which were seemingly linked to a negative mathematics identity and minimal success within the discipline (D. Martin, 2000). Likewise, several researchers have found that academically successful African American students tended to report positive interactions with faculty as attributable to their success in both high school and college (Fries-Britt, 1998; Gutierrez, 2000; Littleton, 2001; Moody, 2004; Powell-Mikle, 2001). In Moody’s (2004) phenomenological study of mathematically successful African American female

students, participants reflected on additional support received from African American mathematics teachers along the way that contributed to their overall mathematical success. These instances demonstrate how the nature of student-teacher interactions might influence mathematics identities, racial identities, and subsequently, mathematical success.

According to Vygotsky (1994), students express their mathematical thinking and understanding through communication with teachers who must make connections between the student's language and mathematical language. This can become increasingly difficult for African American students as certain cultural cues may not be well understood by the teacher and learning activities are not always based on their unique experiences. The successful teacher of the African American student must not only be able to understand the language and cultural cues of each student, but he or she must also be able to assist them with translating this language and understanding into the language of mathematicians. It is this transformation from the students' meanings to taken-as-shared meanings among mathematicians that can become problematic for teachers of African American students. These transformations become even more difficult when curricula, assessment practices, and pedagogy are aligned with Caucasian, middle-class experiences (Tate, 1994). The shared cultural experiences that African American teachers have with African American students can assist with this transformation. African American teachers may serve as cultural translators while communicating high expectations for students. Such teaching methods tend to be successful and are typically supported by the larger African American community (Irvine, 1989).

Teachers can directly impact student success in mathematics as they implicitly and explicitly convey messages to students about the importance and instrumentality of mathematics. Their curricular decisions and expectations of students convey what is valued as mathematical knowledge. As agents of mathematics socialization, teachers also convey messages to students about the norms and values of the discipline (D. Martin, 2000). Irvine (1989) argued for more teachers of minority students (and specifically African American teachers) “who are willing to question and defy rules and regulations that are not in the best interest of their students” (Irvine, 1989, p. 54). In this spirit, teachers of African American students must not only be charged with conveying positive messages about the importance of knowledge acquisition within the discipline of mathematics, but must also be able to make curricular and instructional decisions that will best meet the needs of this population of students. In the process, teachers may need to question existing curricular goals and practices which may not adequately meet the needs of the African American student.

Culturally Relevant Teaching and the Mathematics Education of African American Students

Previously, student achievement has been shown to increase as a result of teaching and pedagogy that incorporates cultural aspects of various minority groups including Hawaiians (Au & Jordan, 1981) and Native Americans (Mohatt & Erickson, 1981). Such culturally compatible teaching practices incorporate certain aspects of a student’s cultural environment into classroom organization and instructional practices (Irvine, 1989). Stiff (1990) and Stiff and Harvey (1988)

suggested that mathematics classrooms could better meet the needs of all students if differences in students' social and cultural orientations are considered, valued, and affirmed through classroom activities. This is consistent with several studies that cited culturally relevant teaching as a motivational and success factor among African American students studying mathematics (Gutierrez, 2000, Silva, Moses, Rivers, & P. Johnson, 1990; Tate, 1995).

Ladson-Billings (1995) defined the term culturally relevant pedagogy as pedagogy which contributes to student achievement, allowing students to “accept and affirm their cultural identity while developing critical perspectives that challenge inequities that schools (and other institutions) perpetuate” (Ladson-Billings, 1995, p. 469). Her theory of culturally relevant pedagogy attempted to ascertain how pedagogy can promote student success, while critically engaging larger, social structural issues. For example, Tate (1995) described a teacher's Afrocentric approach to mathematics pedagogy as she incorporated relevant societal and educational problems that African American students have, and used mathematics (and other academic disciplines) to enact social change. Likewise, The Algebra Project, described as a successful curriculum (Silva et al., 1990), is grounded in African American students' everyday experiences and supported the social construction of mathematics. Through these types of pedagogical practices, mathematics teaching and learning can be centered on the experiences of African American students, providing a venue for students to succeed academically while maintaining cultural integrity (Ladson-Billings, 1995). This can be accomplished through curricular practices that draw upon the cultural experiences of African

American students, and/or the use of language in the classroom that speaks to African American culture. Irvine (1989) describes the use of culturally familiar speech patterns as a necessary component for effectively teaching minority students. This helps to ensure that African Americans and other minority students maintain positive racial and cultural identities throughout their classroom experiences.

Within the discipline of mathematics and mathematics education, Tate (1994) argued for connecting mathematics to the lived experiences of African American students. He proposed that mathematics “pedagogy should try to provide students with opportunities to solve problems using their experiences” (Tate, 1994, p. 482). He went on to comment on the inability of traditional mathematics curricula to provide African Americans with mathematics instruction which centers on their own culture, experiences and traditions. In this way, traditional mathematics curricula have failed to optimize student success in advanced mathematics courses by not promoting the relevance of mathematics to these students’ everyday lives (Tate, 1994). An African American parent in D. Martin’s (2000) study suggested that African American students do not persist in mathematics because they do not see its purpose or utility in their lives. Another parent developed negative attitudes towards mathematics and a negative mathematics identity because her teachers were unable to adequately stress the importance of mathematical knowledge. These are some examples of the devastating effects of preexisting beliefs among African Americans that mathematical knowledge is useless in today’s society. “If such beliefs do exist, there would seem to be an immediate need to address them and an even greater need to develop strategies that promote placing greater emphasis on the instrumental importance of mathematics

among African American adolescents” (D. Martin, 2000, p.56). Culturally relevant teaching and similar pedagogical practices can help to emphasize the utility of the discipline of mathematics among African American students by drawing upon their lived experiences.

Conclusion

From a sociocultural perspective, the mathematical success of African American students can be linked to a variety of non-cognitive factors including social, cultural, and community influences. As we begin to conceptualize mathematical success among this population of students, we must first unpack the mathematical success of African Americans who have achieved and maintained success within the study of the discipline. To truly understand the mathematical success of these high-achieving students, we must take into consideration the many factors that they attribute to their success. Conducting this type of research can begin to address the persistent issue of low mathematical achievement among this student population.

CHAPTER 3: METHODOLOGY

Previous research suggests a variety of sociocultural factors are associated with mathematical success among African American students (Brand, Glasson, & Green, 2006; Ellington, 2006; M.L. Johnson, 1984; D. Martin, 2000; Moody, 2004; Powell-Mikle, 2001; Tate, 1994). This study sought to explore these and various other success factors as identified and conceptualized by mathematically successful, African American students using qualitative research methodology. Data collected from individual and focus group interviews provided information contributing to the current understanding of how these students' perceived certain factors to impact their mathematical success at the community college level.

This chapter begins with a detailed description of the research methodology and epistemological approach used in the study. What follows is a description of the participants, sampling and setting for the study. Next, I will turn to a discussion of the data collection process and analysis procedures. A list of assumptions and limitations follows.

Research Methodology

A qualitative, case study research design was used in an effort to understand mathematical success and success factors among six, African American community college students. This methodology was chosen as the appropriate vehicle to interpret and make sense of mathematical success among this population through the examination of individualized meanings of mathematical success.

According to Merriam (1998), education is a process and school is a lived experience. Research that involves attempting to understand the “meaning of the process or experience constitutes the knowledge to be gained from an inductive, hypothesis- or theory- generating (rather than a deductive or testing) mode of inquiry” (Merriam, 1998, p. 4). Similarly, Cobb and Yackel (1995) describe developmental research from a constructivist perspective as an ongoing interaction during which the emphasis is placed on the way in which students themselves, reorganize their activities. Drawing from a constructivist perspective, I utilized a qualitative method of inquiry to better understand the experiences of these students as they constructed their individual meanings of mathematical success, various success factors, and the relationships between them. Using a sociocultural lens, I planned to better understand the sociocultural success factors that these students identified, and the meanings that they ascribed to these factors as they perceived them to be related to their individual mathematical success. From an emergentist point of view, a concert of both constructivist and sociocultural perspectives were drawn upon for the purpose of data collection and analysis. As the sociocultural factors discussed by students are perceived to be contextual, these factors can be viewed as means by which opportunities are provided for students to individually construct mathematical knowledge. Using this perspective, participants are perceived by the researcher as students constructing mathematical knowledge within various sociocultural contexts. Participants are also perceived to have constructed conceptions of mathematical success while identifying mathematical success factors which are sociocultural in nature.

The qualitative study of mathematical success among African American students from constructivist, sociocultural, and emergentist perspectives is consistent with the overall philosophical assumption of qualitative research as a reality that “is constructed by individuals interacting with their social worlds” (Merriam, 1998, p. 6). The use of qualitative methodology is not only most appropriate for addressing the research questions of this study, but also sets the stage for the results to adequately contribute to the existing body of research in this area. Drawing from these perspectives collectively, the results of this study should assist in the future development of theory which can further explain mathematical success among African American students at the college level.

A constructivist epistemology, as a reaction or response to a positivist epistemology, has also been referred to as postpositivism (Gall, Gall, & Borg, 2003). As defined by Gall et al. (2003), postpositivism is “the epistemological doctrine that social reality is constructed and that it is constructed differently by different individuals” (Gall et al., 2003, p. 15). Researchers that subscribe to this epistemology “believe that the study of individuals’ interpretations of social reality must occur at the local, immediate level” (Gall et al., 2003, p. 17). Within the context of this study, my interest lies in the meanings that these mathematically successful African American students subscribe to various sociocultural factors, and how they perceive these factors to relate to their individual mathematical success at a community college. In order to understand these meanings, I chose to study students who are experiencing this success rather than studying students in general. The local, immediate nature of the individual meanings that these students construct suggests

the examination of specific cases which demonstrate particular instances of this phenomenon (Gall et al., 2003).

The general aim of this study was to better understand mathematical success among this population of students and the various factors that these students perceived as directly impacting their mathematical success. It is my hope that a deeper understanding of what leads to mathematical success will be provided by the results of this study. These results and similar research will eventually result in implications for policy which foster environments that support and nurture these success factors. The implication here is that these identified success factors may be causal in nature, as they in some ways may encourage, support, and foster mathematical success among these students. As this study sought to discover and explore causal success factors, a postpositivist epistemology was deemed most appropriate. According to Gall, Gall, and Borg (2003), postpositivist researchers choose to investigate individuals' interpretations of social reality when looking to discover causal patterns in social phenomena.

Various aspects of the three perspectives (sociocultural, constructivist, and emergentist) were used in an effort to better understand mathematical success among these students. A research methodology which draws from all three perspectives helped bring to light the experiences of these students, through the investigation of certain instances of their success. The nature of this success was evidenced as students constructed their conception of mathematical success as they perceived it to be impacted by various success factors, including those which were sociocultural in nature. Utilizing aspects of all three perspectives provided the opportunity to bring

into consciousness the sociocultural nature of their mathematical success as it was individually constructed by students who experienced it. Table 1 (see pg. 25) outlines how each perspective informed the research methodology for this study.

Case study design as a form of qualitative research methodology was used “to gain an in-depth understanding of the situation and meaning for those involved” (Merriam, 1998, p. 19). As instances of mathematical success among African American students are infrequent, a case study approach was selected to assist the researcher in carefully examining the nature of this success among this population of students. As defined by Miles and Huberman (1994), a case is “a phenomenon of some sort occurring in a bounded context” (Miles & Huberman, 1994, p. 25). Within the context of this study, the phenomenon of interest is mathematical success among African American students; the bounded context is a predominantly White community college in the Mid-Atlantic region of Maryland.

An intensive study of these cases has revealed a considerable amount of valuable information about success in mathematics among this student population. According to Abramson (1992), extreme cases “are essential for understanding the range or variety of human experience, which is essential for understanding and appreciating the human condition” (Abramson, 1992, p. 190). In this spirit, a multicase study explored six of these cases in an attempt to better understand mathematical success among African American college students. Through individual and group interviews, I chose to examine several selected students based on relevant, pre-determined, criteria. Interviews were chosen as the primary method of data collection as they appropriately assisted in identifying and unpacking various success

factors as the students perceived them. The open-ended nature of the interview also allowed for the intensive study of these individuals as specific cases of success.

Participants and Sampling

The flexibility of a qualitative research design allows for the inclusion of both small samples and purposeful or non-random sampling techniques (Merriam, 1998). Purposeful sampling techniques include extreme case sampling and stratified sampling (Gall et al., 2003). This study examined extreme cases focusing only on high-achieving, Black or African American students (in mathematics) who were attending or had recently attended a predominantly White, community college in suburban Maryland. Although students were not stratified into groups based on gender, every attempt was made to include an equal or close to equal number of male and female students in the sample. The sample was limited however, to those students who had met the study's requirements and those who had agreed to participate in the study. The resulting sample included four females and two males. Although not equivalent, the gender composition of this sample was somewhat consistent with the gender composition of the community colleges selected which were about 40% male and 60% female.

The term criterion-based sampling can also be used to describe the sampling procedures applied in this study since all participants were required to meet pre-determined criteria. This sample can also be considered a sample of convenience, since three of the students selected for the study were concurrently attending the institution where I presently teach.

Introductory information on the study was distributed to all full-time faculty members in the mathematics department at Community College One (CC1) via email. Included in the email were the pre-determined criteria. Mathematics faculty reviewed the criteria and recommended students to me directly. Based on the typical diversity of community college students' backgrounds, family situations, and work schedules (Bean & Metzner, 1985), no requirement was made for participants to be considered part-time or full-time college students. Five of the six participants in the study could be considered full-time students (taking at least 12 credits or more per semester) while one student was enrolled in only one course.

Students participating in the study were originally required to have completed three or more, credit-bearing mathematics courses. Each course was required to carry three or more credits and students must have received a grade of B or above in these courses. Among the courses considered, at least one course was required to be a calculus course. Calculus I, Calculus II, and Calculus III were among the courses meeting this requirement.

Originally, all participants were to be students currently attending CC1. As I began the process of trying to locate participants for the study, I immediately became aware of the small number of African American/Black students attending CC1 who would meet the pre-determined criteria. Although I initially identified two students meeting these requirements, one student would not agree to participate in the study and the other was unable to be contacted. After an entire semester of searching, the requirements for participation were relaxed to include transfer students who had recently attended CC1 and students who had taken two credit-bearing mathematics

courses with a grade of B or above. In addition, the pool was opened to include students attending other community colleges within the state of Maryland. Math department chairs at two additional community colleges were contacted via email in an effort to elicit additional participants. This resulted in one participant who attended Community College Two (CC2).

Course requirements were also relaxed as a result of sampling difficulties. Instead of requiring that all students had completed Calculus I, Business Calculus was included as a course meeting the minimum requirement and students currently enrolled in Calculus I with high grades were considered. These are among the changes to the original design of the study which were incorporated in response to a small pool of students meeting the original criteria.

The introductory calculus course was included as a minimum course requirement because of the well documented low rate of success demonstrated by minority (including African American) students in freshman calculus courses (Treisman 1985, 1992). Another consideration in the establishment of this criteria was the role of calculus courses as prerequisites to studying higher level mathematics (Powell-Mikle, 2001). In addition, limited success rates in entry-level calculus courses have led to few minority students pursuing degrees in the Sciences, Technology, Engineering, and Mathematics (STEM) areas. Among those who do advance in these areas, Calculus is perceived as the “gateway” course leading to a successful career in these fields (Murphy, Stafford, & McCreary, 1998). First-semester calculus was also chosen as a minimum requirement in an effort to convey a

consistent level of rigor across all participants while providing a course that was reasonably accessible to community college students.

In order to verify eligibility for students to participate in the study, I reviewed all CC1 participants' student records via the college database system. This system keeps records of all students having attended CC1 and is accessible by full-time faculty meeting certain security requirements. For the student attending CC2, a recent copy of her transcript was submitted. These documents were reviewed to identify the mathematics courses that the students had taken at their institution and the grades that they had received. The search for participants ceased after six eligible students meeting the requirements agreed to participate in the study. This selection of a small sample of case studies allowed for a deeper analysis of individual student perceptions (T.L. Johnson, 2001).

A second criteria required students to self-identify as Black or African American. Faculty members were asked to recommend students who met the academic criteria while fitting the racial requirement. Students were then given an opportunity to self-identify or self-designate as Black or African Americans on a preliminary questionnaire (see Appendix A). This racial self-designation met the requirement for eligibility as set forth by the researcher.

The preliminary questionnaire was distributed to all participants prior to the initial interview. According to Speight (1996), racial identification or categorization through self-designation is identifying or labeling oneself racially using a preferred name, category, or label. In most cases, the preferred name will be the label that the self-designator most often identifies with. In an effort to meet the goals of the current

study, only those students who self-designated as Black or African American on the preliminary questionnaire were allowed to participate. This included students who identified as Black or African American in addition to a racial subcategory such as those of African or Caribbean descent.

General racial categories selected for the questionnaire were consistent with the racial categories identified in a report provided by the United States (U.S.) Census Bureau (2006). Since the study sought to examine student perceptions from a sociocultural perspective, subcategories within the Black/African American racial category were also included as a way to explore possible differences based on cultural affiliations. This idea of cultural difference is consistent with results of Crawford's (in press) study which found that differing cultural values can problematize the learning of mathematics.

Indicated racial subcategories were drawn from Ogbu and Simons' (1998) Cultural-Ecological Theory of Minority Student Performance. This work discusses differing student responses to academic situations based on a student's immigrant status as voluntary (such as those of Caribbean descent) and involuntary (such as those who are descendants of African slaves). These differences in minority responses are thought to be influenced by the history of the people. This includes how and why a particular group became a minority (Ogbu, 1983). It was my intent to use this subcategory system to aid in a more detailed description of each case as participants in the current study included African Americans of American, African, and Caribbean origins. As the study unfolded, these distinctions became even more significant as initial interviews revealed that all participants had familial ties to Caribbean or

African cultures. This manifested itself in that all participants later indicated that they were either immigrants themselves, or were 1st or 2nd generation descendants of immigrants from these regions. Although the purpose of this study was not to interview only American-born Blacks or those without immigrant ties, the fact that all participants in the final sample were tied to Caribbean or African cultures suggests that there may be even fewer instances of mathematical success among American-born Blacks. This disconcerting idea will be discussed further in chapter 5. The acknowledgement of this discovery also influenced how future data was collected and analyzed. This aspect of the data collection and analysis processes will be explained in further detail later in this chapter.

Since the inherent diversity of a community college population easily lends itself to economic diversity, economic information was also requested from all participants. Although this information was not used in the final analysis, the rationale for including economic information was based upon recent results from a National Assessment of Educational Progress (NAEP) study which found that race-related gaps in mathematics achievement between the years of 1990 and 2000 were explained in part, by socioeconomic differences (Lubienski & Shelley, 2003). Likewise, several researchers have found SES (socioeconomic status) to be a predictor of growth in mathematics achievement as trends suggest that students from families with high SES levels grow at faster rates in mathematics than students from low SES family backgrounds (Fan, 2001; Ma, 1999). In contrast, Mooney and Thornton (1999) found that among African American seventh graders, similar ratings on attributions related to mathematical success were found among students with both

high and low SES levels. Since this study sought to explore African American students' perceptions of successfully learning mathematical content, socioeconomic status was included initially as a descriptive characteristic of each participant to illuminate differences and/or similarities across SES levels. Similar to the method of self-designation for racial categorization, students were asked to identify an income range on the preliminary questionnaire which most closely represented their overall household income to the best of their knowledge (see Appendix A). Household income categories listed were selected based upon the income categories outlined in the US Census report for the year 2000 (US Census Bureau, 2000). Although all students did not supply this information and it was not incorporated in the final report, financial information was initially requested from all students. Table 2 provides a summary of the characteristics of each of the study participants. Since all participants self-designated as African American or Black, racial subcategories are included in the descriptions.

Table 2: Participant Profiles

Participant	Racial Subcategory	Age	College	Major	# of math courses taken
Adelle	African descent	19	CC1	Pre-Medicine	2
Adrianna	None	23	CC2	Economics/International Relations	4
Charity	African descent	19	CC1	General studies	4
James	None	22	CC1	Electronics Engineering Technology	3
Ray	Caribbean descent	?	CC1 transfer	Math/Computer Engineering	5
Tina	None	19	CC1 transfer	Pre-Medicine Biology/Biochemistry	4

Participant	Country of Origin	Parent's/Grandparent's Country of Origin	Career Goal	Parents' Highest Educational Level
Adelle	Nigeria	Nigeria	Doctor	Graduate School
Adrianna	America	America/Puerto Rico	Economist	Graduate School
Charity	America	Nigeria	Accountant	Doctorate Degree
James	America	St. Lucia/Bonaire	Electronics Technician	Bachelor's Degree
Ray	Jamaica	Jamaica	Engineer	High School
Tina	Trinidad	Trinidad	Cardiovascular Surgeon	High School

Setting

The colleges selected for the study were CC1 and CC2. CC1 is located north of Washington DC in a suburban, metropolitan area of Maryland (MD). CC2 is located in the greater Baltimore-Washington DC area. These colleges were selected based on their accessibility, the diversity of their student populations and programs, similar student populations, and my affiliation as a faculty member at one of the institutions.

CC1 is a fully accredited, two-year public institution that was founded in the early sixties. With several campuses, CC1 serves a large number of students within the county and the surrounding counties of Maryland. A variety of programs offered at CC1 include associate degrees, certificates, and letters of recognition in dozens of fields. Programs in the areas of science, technology, engineering, and mathematics include Astronomy, Chemistry, Physics, Physical Science, Mathematics, Engineering, and Electrical Engineering Technology.

In the 2006 fiscal year, the college housed about 240 full-time and 660 part-time faculty. During the fall semester, the college reported a credit student enrollment of about 14,700 students; with approximately 40% men and 60% women. Among all students enrolled in credit-bearing courses, about 65% of students identified as Caucasians, 15% as African American, and 25% of students identified as another racial group (excluding students who identified as other as well as those who did not report any racial category). The median age of all students enrolled was 22.

Founded in 1970, CC2 offers a variety of programs including associate degrees, certificates of proficiency, and letters of recognition. The top five transfer

programs that students enroll in are Arts and Sciences, General Studies, Nursing, Business Administration and Teacher Education.

As of the fall of 2006, CC2 housed about 130 full-time credit faculty, 400 part-time credit faculty, and 130 part-time noncredit faculty. During the fall 2007 semester, about 7,500 students were enrolled in credit courses while slightly under 15,000 students were enrolled in non-credit courses. The median age of credit students attending CC2 was 22. This student population was about 60% female and 40% male. Out of the students enrolled in credit courses that semester, about 20% were African American, 10% Asian, 5% Hispanic, 1% Native American, 50% White and 5% other.

Data Collection

Data for the study was collected in the form of semi-structured, individual and group interviews conducted outside of the classroom setting. The interview was chosen as the primary data collection tool for this study based on its flexibility and ability to yield more complete information than questionnaires (Bogdan & Biklen, 1992; Gall et al., 2003). According to Merriam (1998), the interview is the best method of data collection “when conducting intensive case studies of a few selected individuals” (Merriam, 1998, p. 72). Similarly, the open-ended nature of the interview method was found to be most appropriate for addressing the research questions which sought to explore individual student perceptions.

It was my intent to use the semi-structured interview format as a tool to better understand each student’s perception of the identified success factors and how each student conceptualized the relationship between the success factors and their overall

mathematical success at the community college level. The semi-structured interview format provided additional opportunities to follow-up on certain success factors and other related information that may not have been accessible through a questionnaire. According to Bogdan and Biklen (1992), the open-ended nature of the semi-structured interview more easily lends itself for students to answer questions from their own perspective or frame of reference.

In an effort to establish reliability of the semi-structured interview as a data-gathering tool, two students who had recently graduated from college, were interviewed during a pilot study using a proposed interview guide (see Appendix B). Both students were African American and had majored in mathematics at Bowie State University, a historically Black institution in Maryland. Following each interview, I debriefed with the students to ensure the reliability of the interview questions. Questions were then revised based on student feedback and suggestions. The final interview guide was then created (see Appendix C).

During the initial phase of data collection, all six students selected for the case studies participated in a 20-60 minute, semi-structured, individual interview conducted by the researcher in an informal setting such as an empty student lounge or classroom (see Appendix C for interview guide). Within two weeks, each interview was followed by a 20-40 minute second interview for clarification and extension purposes. A unique interview protocol for each second interview was designed for each student based on initial responses to the first interview. The purpose of the second interview was to follow-up on emerging themes. Since initial interviews revealed that all students were tied to immigrant cultures, the interview guides for the

second interviews included questions related to their cultures and how cultural ties may have influenced their mathematical success (see Appendices D, E, F, G, H, and I). This series of individual interviews was followed by a one-hour, semi-structured, focus group interview involving four of the six participants.

The purpose of the focus group interview was to allow participants to voice their views while drawing out the views and opinions of the other group members (Gall et al., 2003). The focus group interview provided an opportunity for deeper description and discussion around previously identified success factors. As a result of the data analysis and transcription of the individual interview data, initial questions to facilitate discussion for the focus group interview emerged. These questions comprised the group interview guide (see Appendix J). As an alternative data source, the group interview provided rich data, contributed to the triangulation of data, and strengthened both the reliability and internal validity of the study.

Data Analysis

All interviews were tape-recorded, transcribed verbatim, and analyzed using qualitative software (QSR NVIVO) to identify major themes across cases related to various success factors and mathematical success. After individual interview data had been collected from three participants, preliminary coding categories were created targeting various mathematical success factors including sociocultural factors. A cross-case analysis was also used in an effort to enhance the possibility of generalizability of the data and to deepen the understanding and explanations gained from the results of the study (Miles and Huberman, 1994). Prior to moving into the analysis, all interview transcripts and preliminary questionnaires for each participant

were read and reread in an effort to get an overall feel of each case, and to better understand each case individually. According to Miles and Huberman (1994), “it is crucial to have understood the dynamics of each particular case *before* proceeding to cross-case explanations” (Miles & Huberman, 1994, p. 207). During this process, I developed generalizations about each case in terms of patterns and how they might compare and contrast with each other as well as published literature on mathematical success among African American students. This method is consistent with qualitative analysis as discussed by Creswell (1998), who proposes that themes should be analyzed for both uniqueness and consistency. Generalizations about each case were incorporated into an early draft of a case summary which was shared with each participant for feedback. This aspect of the analysis will be discussed later as a stage of member checking.

The cross-case analysis conducted called for a variable oriented strategy as described by Miles and Huberman (1994). This strategy was used to identify emerging themes related to mathematical success factors that cut across four or more cases. A variable oriented strategy of analysis requires careful inductive coding including both descriptive and interpretive codes which are used by the researcher to locate recurring themes (Miles & Huberman, 1994). As a result of this process, the following codes (condensed for reporting purposes) were identified in reference to students’ definitions of mathematical success: understanding mathematical content, getting good grades, and liking mathematics as a discipline. Likewise, the following codes (in no particular order) were initially identified in regards to mathematical success factors: liking mathematics, the relevance of mathematics, effort and hard

work, persistence, strong mathematical background, positive mathematics identity, racial responsibility, influences of race, positive peer interactions, parental influence, positive teacher-student interactions, cultural influence, mentors, siblings, extended family, social-cultural capital, math ability, African American community, gender issues, religion/faith, community college environment, and good teaching. A sociocultural perspective was drawn upon throughout the creation of the coding categories. More specifically, as the data revealed that all participants were tied to immigrant cultures, the coding category of cultural influence was created and used to code various examples where students perceived culture to have impacted or influenced their mathematical success. The information gathered as a result of the coding process was recorded and displayed in an unordered meta-matrix in Table 3 (see page 86) as follows. An unordered meta-matrix can combine a large amount of information gathered from several cases into a single chart (Miles & Huberman, 1994). The information displayed in the matrix includes the identified mathematical success factors and their absence or presence among all six cases. Since this matrix is unordered, no additional information is provided in regards to the degree of presence of the success factors within each case. The primary purpose of the matrix was to identify and keep track of the presence and absence of the various success factors identified across the cases. It should be noted here however, that although the unordered matrix was used for display and tracking purposes, success factors are presented in chapter 4 in some order of significance. Those factors identified by all six students are presented first, those identified by five students presented second, and

those factors that were identified by only four participants are presented towards the end of the list.

Table 3: Case-Level Display for Partially Ordered Matrix: Identified Mathematical Success Factors

Case	Positive Peer Interactions	Mentors	Parental Influence	Siblings	Extended Family	Positive Student-teacher interactions	Cultural Influences
Adelle	x	x	x		x	x	x
Tina	x	x	x		x	x	x
Ray	x	x	x	x	x	x	x
Adrianna	x		x			x	x
James	x		x			x	x
Charity	x		x	x		x	x

Case	Social-cultural Capital	Math Ability
Adelle		
Tina	x	
Ray		
Adrianna	x	x
James		x
Charity	x	

Case	African American Community	Gender Issues	Religion/Faith	Racial Responsibility	Influences of Race	Positive Mathematics Identity
Adelle			x			x
Tina		x		x	x	x
Ray	x			x	x	x
Adrianna	x	x		x	x	x
James					x	x
Charity					x	x

Case	Love of Math	Relevance of Math	Good Teaching	Community College Context	Strong math background	Effort	Ability to Persevere
Adelle	x	x	x	x	x	x	x
Tina	x	x	x		x	x	x
Ray	x	x	x		x	x	x
Adrianna	x	x			x	x	x
James	x	x	x		x	x	x
Charity	x	x	x	x	x	x	x

To assist with identifying and verifying concurrent themes, two peer debriefers were consulted. Peer debriefing has previously been defined by Lincoln and Guba (1985) as “the process of exposing oneself to a disinterested peer in a manner paralleling an analytic session and for the purpose of exploring aspects of the inquiry that might otherwise remain only implicit within the inquirer’s mind” (Lincoln & Guba, 1985, p. 308). Cooper, Brandon, and Lindberg (1997) similarly describe how peer debriefing was extremely helpful when used in the final stages of data analysis, helping researchers to understand research findings. Assisting with the analysis of the data, peer debriefers can also strengthen internal validity, reveal researcher bias, and provide opportunities to test emerging hypotheses (Lincoln & Guba, 1985).

Following the preliminary coding process, one peer debriefer read the individual interview transcripts and attempted to code the data using the predetermined coding categories. Each debriefer was provided the opportunity to question coding categories, identify new ones, and clarify the meaning of the codes and how they might be applied to the data. The peer debriefer made recommendations which included amending and in some cases redefining the coding categories. Following a thorough review of the peer debriefing analysis and further consultation, preliminary themes and coding categories were revised and expanded. A final category system was used to code all transcripts and common themes were identified and stated as assertions in chapter 4.

The role of the second peer debriefer was to read and examine the themes as well as the evidence from the data which was thought to support these themes. This peer debriefer was consulted frequently throughout the analysis process and made recommendations which included questioning evidence provided for emerging themes. These suggestions were reviewed and incorporated as appropriate prior to reporting the study's findings.

In an effort to maintain the reliability of the interview as a method of data collection, all interview transcripts and case summaries were shared with each participant for member-checking purposes. Prior to each second interview and the group interview, students were asked for feedback and corrections were made to case summaries and transcripts as requested by the participants. Although a sociocultural framework of analysis was used, no attempt was made to influence the response of the participants. A timeline for data collection and analysis is included in the appendix (see Appendix K).

Assumptions

During the course of this study, several assumptions were made that are consistent with previous research in the area of mathematics education and achievement among African American students. These include:

- African American students often do not perform as well as other ethnic groups in the area of mathematics (Education Trust, 2003; Harrell & Forney, 2003; Hoffman, Llagas, & Snyder, 2003; M. L. Johnson, 1984; National Assessment Educational Progress, 2000; Oakes, 1990; Reese,

Miller, Mazzeo, & Dossey, 1997; Stevens, 1995; Treisman, 1992; U.S. Department of Education, National Center for Education Statistics, 2004).

- Currently, there is minimal research and scholarship in the area of academic success among African American students attending community colleges (Bush, 2004; Green, 2003; T. L. Johnson, 2001).
- Currently, there is minimal research and scholarship which explores African American students' perceptions of mathematical success and failure (Powell-Mikle, 2001).
- A majority of research currently available in the area of mathematical success and failure among African American students closely follows a deficit approach (Perry, Steele, & Hilliard, 2003; Powell-Mikle, 2001).
- Various sociocultural factors are seen to impact persistence and success among African American students in mathematics (Brand et al., 2006; M. L. Johnson, 1984; D. Martin, 2000; Moody, 2004; Powell-Mikle, 2001; Tate, 1994).

Limitations

While conducting this study, several major limitations were discovered.

Although a small sample size allows for a deeper analysis of mathematical success factors, small samples limit the generalizability of results. Additional studies in this area should utilize larger samples to investigate mathematical success among this population of students. Similarly, since the sample was drawn from only two institutions and a single ethnic group, generalizability of results among all African American community college students and community college students of other

ethnic backgrounds is inappropriate. Students of other ethnic backgrounds and those attending differing institutions may have different collegiate and mathematical experiences than that which are portrayed in this study. Future studies should seek to examine the mathematical experiences of college students of various ethnic groups and those attending various institutions. In regards to exploring the mathematical experiences of minority students, researchers should also consider comparative studies which examine and compare these experiences with those of Caucasian students.

Several limitations to a case study research design are also apparent. According to Merriam (1998), case study research limits the generalizability of findings as results are based on individual cases of the phenomenon. Likewise, the internal validity of case study research is also questionable as no real guidelines exist in regards to data collection and analysis processes (Merriam, 1998). For this reason, analysis results may be compromised. To address these issues, several aspects of the methodology previously described were added to the research design to increase the validity of the results. Miles and Huberman's (1994) *Qualitative Data Analysis* and a few additional sources were consulted. These texts served as valuable resources and provided considerable direction for drawing valid meaning from the data collected as a result of this research.

The study's reliability on self-report data as a primary data source can also be problematic. Internal validity can be called into question when there is no way to confirm that participants are providing candid responses to interview questions. To begin to address issues of internal validity, verbatim transcription followed by

member-checking was used to verify that what is reported was indeed what was stated and intended by the participants in each case. During the introductory phase of each interview, students were assured that they would not be penalized by me or their institution in any way as a result of their responses to interview questions. Lastly, the review of student transcripts and records via the college database system also assisted in addressing issues of internal validity regarding student characteristics. These records served as an additional data source for triangulation purposes.

The Role of the Researcher

Although peer debriefers were consulted during data analysis, all data were collected exclusively by the researcher. As previously indicated, there is the possibility of researcher bias which may have skewed the results of this work. While extreme caution was used throughout the data collection and analysis processes, my personal interest in the issues being studied might have affected the results or conclusions drawn. Although the use of peer debriefers may have limited or eliminated this effect entirely, I will discuss my position as a researcher, professor of mathematics, previous mathematics student, and member of the population in question in an effort to provide a true picture of the current study's findings.

While interviewing participants, my ethnicity as an African American may have provided some level of comfort to the students. This may or may not have been possible had I belonged to a different racial group. This level of comfort allowed for easy conversations around issues such as perceived racial discrimination and how these students felt as one of few African American students within a predominantly White environment. A bond was established with each participant which allowed easy access to student perceptions and feelings concerning the issues examined in this study. As a result of perceived shared experiences, I was also able to establish some level of researcher credibility. In addition, my familiarity with issues specific to African American students was utilized to inform my selection of interview questions. This perhaps resulted in the collection of richer data which positively contributed to the findings of this

study. Despite this perceived benefit, my shared experiences with these students may have also skewed or tainted the data collection and analysis process as I am extremely connected to issues of race as it pertains to participation in mathematics. To offset this effect, one of the peer debriefers selected was a Caucasian male. Drawing from an entirely different perspective, his comments and suggestions were examined, noted and incorporated into the analysis as deemed appropriate. Involving a non-African American in the data analysis process contributed to the validity of the findings while limiting the effects of researcher bias.

While I was able to establish a level of comfort with the participants as a member of their racial group, this comfort level was limited as students perceived me to also be a member of the mathematics faculty at one of the participating institutions. Although students appeared willing to discuss issues of race and racialized experiences, I often discovered that these students felt uncomfortable discussing negative aspects of a professor's teaching or negative interactions with faculty. While participants were comfortable discussing these issues initially, additional probing revealed that students were only willing to go so far when it came to personal problems or issues with faculty. This occurred even though students were reminded that the actual names of faculty would not be printed in any documents. As a result, it is entirely possible that the data collected was not complete in this area. Future studies should consider having a non-faculty member assist with the data collection process to avoid this issue.

My position as a faculty member at this institution could also impact the findings as I am intimately connected with one of the institutions and have a vested interest in the mathematical success of their students. My interest in the mathematical success of community college students is what led me to this topic. As a community college professor of mathematics, I hope to make a positive impact on my students and successfully teach them the mathematics they need to know in order to be successful. Intermittently using this lens, I saw implications for mathematics faculty and ways to improve student success as I collected and analyzed the data. Drawing from this perspective, researcher bias is extremely possible. In an effort to limit bias, I consulted a second peer debriefer who was not a mathematics professor. Input from this debriefer was incorporated into the data analysis, increasing the validity of the findings.

My dual role as an African American and successful student of mathematics also provided a unique perspective while researching this area. As an undergraduate student, I majored in mathematics while attending a predominantly White, four-year institution in Maryland. As a result, I admit to having shared experiences with the participants. For example, I too recall being one of few African American students in upper level mathematics courses. Drawing from this perspective, I was able to better understand and appreciate these student accounts. I was also able to draw from my experiences spontaneously, asking probing questions appropriately to gather additional information. These skills seemed to contribute to the richness of the data that was collected. Although these skills may have positively contributed to the research process, researcher bias is highly

possible. From the perspective of a previous African American student of mathematics, shared experiences with the participants may have skewed the data. In order to address these issues of researcher bias, neither peer debriefer could draw from this unique perspective as an African American student studying higher-level mathematics at the college level. Differing perspectives of each peer debriefer limited the effects of researcher bias and greatly contributed to the overall validity of the results.

CHAPTER 4: RESULTS

This chapter is comprised of the results of the analysis of data collected for this study. The results will be organized around the research questions. The purpose of the first research question was to understand each student's perception of mathematical success. The second and third research questions sought to examine the participants' perceptions of mathematical success factors and how they perceived these factors to directly impact their mathematical success at the community college level. The findings presented here were based on data collected from two individual interviews with each participant and one group interview with four of the participants. In total, there were 13 interviews conducted between December of 2006 and July of 2007.

The chapter begins with case summaries for all six participants followed by a definition of mathematical success as perceived by the participants. This definition is based on the interview data collected, and was used as a basis for identifying mathematical success factors throughout the data analysis. The success factors identified by the students will be presented in order of significance as follows: (a) Parental influence, (b) perseverance despite challenges, (c) individual effort and hard work, (d) student-teacher interactions, (e) the relevance of mathematics, (f) the love of the discipline, (g) cultural influences, (h) strong mathematical backgrounds, (i) mathematics identities, (j) positive influences of race and racialized experiences, (k) good teaching, and (l) peer interactions. A cross-case analysis (Miles & Huberman, 1994) was used to determine the order of significance as the factors discussed here are limited to those which were identified by four or more students. Likewise, those

listed first were identified by the most participants (five or six), and those near the end of the list were identified by only four of the participants. Although this method was used to present the factors in some order, no distinction was made between factors identified by the same number of participants such as those identified by only four participants. Examining the degree of presence of each of these factors was beyond the scope of this study.

Participants

In order to get an overall feel of each case, all individual interview transcripts and preliminary questionnaires for each participant were read and reread in an effort to better understand each case individually. During this process, I developed generalizations about each case examining how they might compare and contrast with each other and previous literature in this area. These generalizations were incorporated into a case summary which was shared with each participant for feedback. Case summaries were then revised based on feedback from the participants. What follows are the final case summaries as a result of this work.

Case Summary #1 (Adelle Taylor)

Adelle Taylor is a 19 year-old community college student who currently attends Community College One (CC1). She is a pre-med major and was enrolled in Calculus 2 at the time of the first interview. Currently, she is considering studying biomedical engineering upon transferring to a four year institution. Although she has not yet specified an area of specialty, Adelle plans on becoming a medical doctor or

working professionally within the health field. Adelle was recommended to me by her Calculus 2 professor.

Adelle considers herself to be a very good mathematics student and has taken several mathematics courses at CC1 including Calculus 1 and Calculus 2, receiving an A and B in both courses respectively. In addition to receiving high grades in her math courses, Adelle also works as a peer tutor in the math tutoring lab on campus. On average, Adelle takes 12 credit hours per semester, but had taken 15 credit hours during the fall and spring semesters of the 2006/2007 school year. During an average semester, Adelle works part-time 12 hours per week. She plans to receive her Associate's degree in the spring of 2008, and plans to transfer to a four-year institution to complete a Bachelor's degree by 2010.

Born in Nigeria, Adelle self-identifies as Black or African American of African decent. Adelle has lived in the United States (US) since September of 2005 and is here attending college on a student visa. In their fifties, both of her parents still live in Nigeria. They hold Master's degrees and are currently pursuing their Ph.D.'s.

Adelle identifies mathematical success with getting good grades and seems to have a positive mathematics identity. She describes math as something she can do when she puts her mind to it. In secondary school back in Nigeria, Adelle chose to take an advanced mathematics course which exposed her to integral and differential calculus prior to college.

Adelle had difficulties in mathematics early on and began to perform poorly in grades three through six. Her parents eventually hired a tutor who assisted her daily in math throughout this period. With the assistance of the tutor, Adelle's grades started

to improve. It was during this time that she also began to feel mathematically successful. Since she was not always good in math, mathematical success is extremely important to Adelle. During the interviews she expressed a genuine interest in mathematics and acknowledged the importance of mathematics to her future career goals.

Adelle identifies several disciplinary, institutional, and sociocultural factors which appear to directly impact her mathematical success at the community college. As a result of increased success, Adelle has grown to like the discipline of mathematics and now finds math interesting. During our first interview, Adelle immediately identified the math tutoring lab as a major success factor. She speaks positively about the help she received from the math tutors and how these experiences motivated her to become a math tutor. Positive interactions with peers and classmates outside of the tutoring lab also provided both emotional and academic support. In addition, Adelle also describes positive interactions with math faculty who were always available to answer her questions.

Adelle currently lives with her aunt who is an engineer. Adelle's aunt is always available to help her with her math and frequently asks her if she is having any problems. Like her aunt, Adelle's parents stay on top of her grades. This helps motivate her to keep her grades up.

Adelle was the only participant to bring up the topic of religion or faith as a factor of success. Adelle prays constantly about her grades and classes and thanks God for her academic success. Adelle was also the only participant to have immigrated from Africa (Nigeria) and to have been a peer tutor in the math lab.

Case Summary #2 (Adrianna Carlos)

Adrianna Carlos is a 23-year-old student who attended Community College Two (CC2) during the spring semester of 2007. At the time of the first interview, she had already received Bachelor of Arts degrees in Economics and International Relations (Spring 2006) and was currently taking Calculus 1 at CC2. She was recommended to me by her Calculus professor who said she was likely to receive an A in the course. She did not declare a major at CC2, but desires to enroll in Calculus 2 in preparation for a graduate degree program in Economics. In addition to Calculus 1 where she received a final grade of a B, Adrianna also took College Trigonometry at CC2 where she received an A. At American University where she received her Bachelor of Arts degrees, Adrianna took Finite Mathematics and Basic Statistics where she received an A and A- respectively. Her dream job would be to become an international economist for a non-profit or non-government organization. Adrianna is the only participant who had already earned a Bachelor's degree, was working full-time, and had not attended CC1.

Adrianna considers herself to be a good mathematics student. As a part-time student, Adrianna took only three credits (one math course) per semester on average while working full-time analyzing data for a research company. Adrianna was born in the US like her parents, though her grandfather is from Puerto Rico. Both of her parents have completed coursework towards Master's degrees. On the preliminary questionnaire, Adrianna identified herself as Black or African American.

Adrianna defines mathematical success as understanding mathematical content, being able to apply what she has learned, getting good grades, and being able

to understand the content better than her peers. Adrianna seems to demonstrate a positive mathematics identity even while others seem to doubt her abilities. Early in her mathematical career, her fourth grade math teacher served as a mentor, motivator, and cheerleader for Adrianna. High expectations set forth by this teacher challenged Adrianna's abilities, seemingly increased her confidence and helped her to foster a love of the discipline. Adrianna continues to carry this love of math throughout her mathematical studies at the college level. The high expectations and challenging curriculum set forth by this fourth grade teacher also contributed to a strong background of mathematical knowledge. Adrianna brings this knowledge to her current college coursework. Additional personal success factors identified by Adrianna include mathematical ability, an ability to overcome personal challenges, and hard work.

Adrianna also perceives several sociocultural factors to be directly related to her mathematical success at the community college level. Even though they were not very good at mathematics, Adrianna's parents pushed and encouraged her to do well in the discipline. Her paternal grandfather, an aerospace engineer, also strongly encouraged her in this area. His influence motivated her to succeed within the discipline. Adrianna perceived these interactions with family to greatly contribute to her mathematical success.

Throughout the interview, Adrianna described both positive and negative interactions with peers at the community college which directly impacted her mathematical success. Although she did not study with her peers regularly, Adrianna admits to checking in with them to judge how well she understands the material

comparatively. She also admits that if her peers were not doing well, she would not push herself as much. Adrianna also elicits advice from older students who have previously taken these classes, to see if she is on the right track.

Adrianna described about 50% of her interactions with math faculty at CC2 as negative. In her perception, these professors consistently conveyed lowered expectations and were surprised when she did well. These negative student-faculty interactions were also present throughout Adrianna's educational experiences in elementary, middle, and high school. It is Adrianna's perception that racial discrimination played a major role in these relationships and interactions. Instead of allowing herself to be defeated by these negative experiences, Adrianna actively chose to prove her teachers wrong and consistently performed well on her tests and quizzes.

Adrianna generally seems to like mathematics as a discipline. This makes it easier for her to do well in her mathematics courses. Evident also is the connection that Adrianna has made to the discipline of mathematics and her future career goal as an economist. The relevance of math to her everyday life and career serves as an additional motivating factor. It should also be noted that Adrianna was the only participant who seemed to have experienced a significant number of negative racialized experiences with mathematics professors. Despite these negative experiences however, Adrianna consistently strove to succeed mathematically.

Case Summary #3 (Charity Miller)

Charity Miller is a 19 year-old, community college student currently attending CC1. Majoring in general studies, Charity wishes to become an accounting major

upon transferring to a four-year university in Maryland. Her immediate future plans include participating in an internship at an accounting or investment firm before graduation. Charity would eventually like to become an accountant.

Charity generally takes 16 to 17 credit hours each semester and works anywhere from 20-35 hours per week at a part-time job. This helps her contribute to financing her own education. Charity considers herself to be an excellent mathematics student and has taken several mathematics courses at CC1 including Intermediate Algebra (developmental), College Algebra, Elementary Statistics, and Business Calculus. Charity received a grade of A in all of these courses. Her considerable success in mathematics seemingly contributes to an overall positive mathematics identity.

Charity identifies herself as Black or African American even though her parents are from Nigeria. Although she was born in the US, Charity lived in Nigeria from June 2001 to January of 2004. She currently lives with her parents and five siblings. Her mother has a Bachelor's degree in accounting while her father holds a Ph.D in Biblical Studies.

Charity defines mathematical success as doing your best, liking math and getting good grades. She seems to take personal responsibility for her mathematical success and often speaks of doing her part. Among several success factors, Charity lists the math tutoring lab and approachable instructors as sources where help is readily available. She speaks highly of most of her math professors and the importance of having teachers who care. Although these factors appear to greatly

impact Charity's success, it appears that these factors simply set the stage as Charity contributes her own individual effort and hard work.

Charity studies immediately after each class, often asking questions of her professors both inside and outside of the classroom. If she is having difficulty with a concept, Charity will use the internet to research the topic online. These activities are consistent with doing her part in order to succeed.

Institutional factors such as small class sizes also provide positive classroom environments where Charity feels comfortable asking questions in class. Charity admits to feeling more comfortable in the predominantly White classroom environment of CC1 as opposed to an environment which is predominantly Black. When asked about this, she stated that she had grown up around mostly White people and was more comfortable in this environment. As a result, race does not seem to be a major issue for Charity academically, as she sees herself as not an African American student, but simply a hard-working student trying her best to succeed. The role of race as it plays out in Charity's mathematical and academic experiences is further discussed later in this chapter.

One of six children, Charity is motivated to succeed mathematically so that she can remain competitive amongst her siblings. She states that her siblings constantly compete to be the best in a variety of areas including academics and sports. According to Charity, her mother is more involved in her schooling and education than her father. She strives for academic success so that she can make her mother proud. Charity was the only participant to have received A's in four or more

mathematics courses taken at the college level. Charity was recommended to me by her Business Calculus professor.

Case Summary #4 (James Chisholm)

James Chisholm is 22 years old, and is currently attending CC1. He began attending CC1 in 2003 and plans to transfer to a four-year institution in the spring of 2008. James plans to receive his Bachelor's degree in Electronics Engineering Technology in December of 2008 and wishes to become an electronics technician in the future. During the semester, James works approximately 25 hours per week. He takes 10-12 credit hours per semester and works full-time over the summer.

James was born and raised in the US although his parents are from Bonaire (mother) and St. Lucia (father). On the preliminary questionnaire, he identifies himself as Black or African American of Caribbean descent. Both his parents are college educated. His mother received a Bachelor's degree in Accounting while his father received two Bachelor's degrees. James is a middle child with two brothers.

James considers himself to be a good mathematics student and has taken several mathematics courses at CC1 including Pre-calculus, Intermediate Algebra (developmental), and Calculus 1. James received an A in Pre-calculus and Intermediate Algebra, and received a high B in Calculus 1. James was recommended to me by his Calculus 1 professor.

James defines mathematical success as understanding mathematical content, having an ability to overcome challenges, and receiving a grade of B or above in his math courses. James perceives math ability, parents who were also good at math, hard work, good teaching and the math tutoring lab to be factors impacting his success. In

addition to these contributing factors, James was also exposed to mathematically successful African American peers during his elementary, middle, and high school years. As a result of these experiences, James does not perceive race to be in any way related to his ability to succeed mathematically. The role of race in James' case is discussed in more detail later in this chapter.

James perceives his success in mathematics to be extremely personal and individual. He attributes this success to having an inherited ability to do math and does not often take advice or suggestions from others. This success also appears to be strongly connected to his ability to persist and persevere through difficulties. James often mentions working the same or similar problems over and over again until he is able to understand the concepts. His tendency to rely on his own ability to push through difficult mathematical content suggests a positive mathematics identity overall.

Case Summary #5 (Ray Charles)

Ray Charles currently attends a four-year, state university. He transferred there from CC1 in 2005. Ray attended CC1 between the years of 2003 and 2005. During this time, he took an average of 12 credits per semester and worked about 20 hours per week. Ray did not provide his age on the demographic questionnaire.

Ray was a mathematics major while attending CC1 and is currently majoring in Computer Engineering. He plans to be an engineer when he graduates. He considers himself to be "very good" in mathematics and self-identifies as Black or African American of Caribbean descent. Although he was born in Jamaica, Ray has lived in the US since 1993. Ray was recommended to me by his Calculus 1 teacher

and has taken various mathematics courses at the college level including Calculus 1, Calculus 2, Calculus 3, Differential Equations and Linear Algebra. Ray received the following grades in these courses respectively: A, C, B, A and A.

Ray chooses to identify mathematical success primarily with understanding mathematical content, an ability to teach mathematical content to others and good mathematical performance when compared to others. Ray describes a love of the discipline of mathematics that emerged as a result of intense preparation for an important high school mathematics exam. Additional success factors identified by Ray include a strong mathematical background, hard work and a determination to succeed.

As a first generation college student, Ray was confronted with many challenges along the way as he tried to succeed and persist within the study of the discipline. Through his many experiences, Ray demonstrated an impressive ability to overcome these challenges. In addition, Ray consistently conveyed a strong desire to help other students and give back to the African American community. This was evidenced as he actively sought out opportunities to tutor other African American students and expressed a desire to someday teach high school students back in Jamaica. This personal desire to give back motivated him to stay “on top of his game” mathematically, contributing to sustained success within the discipline and the formation of a positive mathematics identity.

Early in Ray’s mathematical career, an important interaction with an older student was instrumental in helping him to develop a love of the discipline. Likewise, positive interactions with a mentor teacher at the community college directly

contributed to his success. Professor Kendall not only provided academic support to Ray outside of the classroom, but also consistently provided him with encouragement along the way. Positive interactions with other community college professors in both math and a variety of disciplines were also described by Ray as success factors. For example, Ray consistently sought and received help from several math faculty including the chair of the math department. These positive interactions with faculty seemed to attribute to his success.

Interactions with peers and other African American students through tutoring and study groups also contributed to his persistence in mathematics. Likewise, Ray describes his parents as directly responsible for his success. As a first generation college student, Ray perceived his parents to be instrumental in developing him as an independent and determined individual.

Ray perceives race to play a significant role in his ability to succeed mathematically. He feels a responsibility to represent positively for his race and cultural group as an African American student and as a person from the Caribbean. This sense of responsibility drove him to succeed and motivated him to help other African Americans to succeed mathematically as well.

Case Summary #6 (Tina Thompson)

Tina Thompson is a 29-year old student who recently transferred from CC1 to a state university upon receiving an Associate's degree in 2006. While attending CC1, Tina was a pre-med major and took an average of 15 credits per semester. She also worked an average of 20 hours per week at a part-time job. At the university, Tina

currently double majors in Biochemistry and Biology. Upon completion of medical school, Tina plans to become a cardiovascular surgeon.

Tina considers herself to be a very good mathematics student and has taken various courses in mathematics at the community college level including Intermediate Algebra, Pre-calculus, Calculus 1 and Calculus 2. Tina received a B in all of these courses and was recommended by her Calculus 2 professor.

Tina has always liked math and considers herself to be competent in it. Although she struggled with identifying herself racially, Tina chose to write Black in the space for “other” on the demographic questionnaire. She considers herself to be brown and not Black. She reluctantly identified herself as Black stating that this is how she feels that society sees her. Later however, Tina reveals that she was disappointed to be the only African American student in a Calculus 2 class. Tina’s racial experiences will be discussed later in this chapter.

Tina was born in Trinidad and came to the states in 2003. Presently not a US citizen, Tina is the first person in her family to attend college although her mother holds a certificate in nursing. A child from a single parent household, Tina is responsible for paying the majority of her college tuition.

Tina defines mathematical success as knowing how to overcome challenges. Upon completion of the college mathematics placement test, Tina discovered that she was not eligible to take credit-level mathematics. Later, Tina failed Pre-calculus the first time around and had to retake the course. Her ability to eventually complete the course with a grade of a B, allowed her to feel successful in the study of mathematics.

Tina ultimately defines mathematical success as her ability to overcome academic challenges, persistence and the fact that she never gave up.

Tina spoke very highly of the math tutoring lab on campus. Although she was not a tutor herself, she appreciated the community of math students working there and had several positive interactions with peers that allowed her to successfully teach other students mathematical content.

Tina's success in mathematics may also be a result of positive interactions with her mother. She often described encouraging words from her mother when she did not do well mathematically. As a first generation college student, Tina described having to learn the mathematics so that she could bring this knowledge back to her mother, extended family and future generations.

Tina perceives positive interactions with caring math professors at the community college to directly contribute to her mathematical success there. In addition, Tina discusses a mentor who has tutored her in math and science throughout her college years. She perceives the help she has received from her mentor to have also contributed to her success. Despite the academic support she has received, Tina is also very much aware of her lack of social and cultural capital as a first generation college student. For the purpose of this dissertation, social capital will refer to a collection of networks and social resources that encourage one's self or another's educational achievement or attainment (Hemmings, 2007). Cultural capital will refer to valued knowledge (both academic and mainstream cultural) and the attributes which define one's class status as it is derived in part, from one's parents (Bourdieu, 1986; Bourdieu & Passeron, 1977). This knowledge can help contribute to a student's

academic success in a variety of educational settings. Recognizing this deficit, Tina does not refer to this lack of social and cultural capital as an excuse to perform poorly academically, but sees it as a motivational factor which contributes to her determination to succeed.

Gender also appears to be a motivational factor for Tina since she was motivated to perform well as one of few females in a Calculus 2 class. Although Tina did not easily identify with being African American, she acknowledged that she was also the only African American student in this class. As a result, Tina was motivated to succeed academically as she represented for both her gender and her race. Tina's initial reluctance to deal with and address issues of race presents some additional challenges regarding how Tina views herself throughout her participation in school and collegiate mathematics. These issues are further discussed in chapter 5.

Like Ray, Tina describes a strong desire to give back to her family and community. In addition to bringing back mathematical knowledge to her family, Tina wants to one day return to CC1 and tutor students in both mathematics and science. Her career choice, to become a cardiovascular surgeon, is also motivated by a desire to help others.

Tina describes math as a discipline that builds upon itself. For this reason, she desires to learn more mathematics even though it is not a requirement of her program of study. She is acutely aware of the relevance of mathematics to her science coursework and how mathematical knowledge is relevant to her future career as a doctor.

A Definition of Mathematical Success

Previous research in the area of mathematical success among African American students has provided us with various working definitions of mathematical success. In a study examining mathematically successful African American females at the college level, Moody (2004) defined mathematically successful students as those who had completed a calculus sequence and one upper level mathematics course beyond calculus, were currently enrolled in a second upper level mathematics course, and/or those who perceived themselves to be mathematically successful. Likewise, Powell-Mikle (2001) identified mathematically successful African American college students for her study as those who had satisfactorily completed a similar Calculus series of three courses. When identifying high-achieving African American youth, D. Martin (2000) originally defines students who are mathematically successful as “students receiving high grades in mathematics and expressing positive attitudes about mathematics learning” (D. Martin, 2000, p. 124). As their stories were analyzed, he later expands this concept of success to include exemplary behaviors that distinguished these students from their peers. Among these behaviors were resisting anti-achievement norms, which comprised the majority of the attitudes and behaviors of their peers and classmates. According to D. Martin (2000), these students were socially and mathematically different from their peers. As evidenced in Chapter 3, aspects of these definitions were drawn upon and modified to create pre-determined criteria for the current study’s participants. Although these definitions assisted with developing criteria for the participants to meet, not all of these definitions incorporated information regarding how the students themselves defined

success in mathematics. Since this study sought to understand mathematical success and success factors from the students' perspectives, it seemed only fitting that I also examine how these students defined mathematical success.

In an effort to address the first research question regarding students' perceptions of mathematical success, all participants were asked two central questions during their first interview:

1. What is mathematical success to you?
2. What made you feel successful?

The purpose of these questions was to determine how these students defined mathematical success prior to examining their perceptions of mathematical success factors. As a result of the data gathered, four or more of the participants identified mathematical success with understanding mathematical concepts and content, obtaining good grades, and/or liking mathematics as a discipline. Various other definitions of mathematical success included how one understood mathematics and performed mathematically when compared to other students, one's ability to apply mathematical concepts, one's ability to persist within the study of the discipline, and how one successfully teaches others mathematical content. For the purpose of this analysis, I will focus on the most common aspects of the definition as described by at least four of the participants.

Understanding Mathematical Content

Throughout the participants' definitions of mathematical success was an underlying theme of understanding mathematical content. Instead of focusing on a correct procedure or solution, most students saw the importance of understanding

how and why a problem could be solved a certain way. This suggests that in regards to defining mathematical success, most students placed equal value on conceptual and procedural knowledge. Ray, Adrianna, James, Charity and Tina discuss the importance of understanding mathematical concepts, problems and procedures. For example, Ray offers the following observation about understanding math: “As for me, I guess the concept of mathematics would be more of me understanding math. Not solving every problem, but understanding the idea of that problem.” Adrianna also understood the link between understanding concepts and mathematical success. According to her definition, mathematical success does not rest entirely with the end result, but whether or not you are able to understand the material. The following quote illustrates this understanding:

...mathematical success to me is more understanding what concepts the teacher has brought up, and maybe being able to use that in a more advanced level. It's not necessarily getting the best grades in the class, but kind of just understanding the concepts. And if you understand that, then I think you've been successful...I would say that I feel mathematically successful if...I was just able to understand the concepts that the professor...is teaching...but even to just kind of get a general idea of what they're talking about and be able to follow...I think that's mathematically successful.

Similarly, Tina discusses the importance of not only being able to do the mathematics procedurally, but also being able to understand your procedures and the reasoning behind mathematical problems and solutions. She stated, “if you do

an equation and this equation will get you this, if you understand...why you're using the equation, well, then, voila, you've got it! You know what you're doing."

Good Grades

Several students also perceived the accomplishment of obtaining good grades as an indication of mathematical success. Adelle describes how improved grades in math made her feel mathematically successful. Similarly, Adrianna, James, and Charity felt that good grades exemplified mathematical success at the college level. The following quote by Charity is representative of this finding: "Basically getting good grades...made me feel successful. When you get an 'A' on every single test, then...it makes you feel that you did your best ...and then you can really do it."

Liking Mathematics as a Discipline

Lastly, four out of the six participants defined mathematical success as liking mathematics as a discipline. Across these cases, there appeared to be a relationship between each student's mathematical success and how mathematics appealed to them as a discipline. Ray, Charity and Adelle all seemed to develop a love for mathematics as they became more successful in it. For Adelle, liking mathematics, becoming successful in math, and valuing mathematical knowledge all occurred simultaneously. Adelle's quote below demonstrates these events:

Well, mathematical success is something that's very important to me.

When I was much younger, I was almost a failure in math...I did really bad in math. But over time, it got better and better, and I've grown to like

math more and more. So...subsequently, math has been really important to me. I think math is interesting, that's what I think.

As a high school student, Ray developed a love for the discipline of mathematics as a result of studying with an older student back in Jamaica. During this time, he began to feel mathematically successful while simultaneously developing a deeper appreciation for the discipline. In his perception, mathematics is unique in that answers are either right or wrong. His love and appreciation of various aspects of the discipline are evidenced in the following quote:

...I was brainwashed that...[math] was the only real subject ever taught in school, because there was never a wrong answer...never an in-between answer...It was always right or wrong, unlike a couple subjects that I've been [in] where it was up to the instructor to decide whether it was correct or not. But math, you get it correct or not correct, and that's when I learned to appreciate it. That was the only thing that made sense to me as a subject in school. And that's when I think I grew successful in mathematics.

Similarly, Charity began liking mathematics as a discipline while she became more mathematically successful in grade six. The following quote by Charity reveals the connection between becoming mathematically successful and liking mathematics as a discipline: "...[In sixth grade] I started liking math and doing really well in it; and basically every test...quiz we had in class. That's when I started enjoying and liking math, and...trying to do my best at it."

Although Adrianna and James did not specifically identify mathematical success with liking math, interview data revealed that both students liked mathematics early on. This contributed to their mathematical success at the college level. The connection between liking mathematics as a discipline and mathematical success is discussed in more detail later in this chapter and again in chapter 5. For many participants, one serves as a catalyst for the other. In other cases such as Charity and Adelle, beginning to like mathematics and feeling mathematically successful were simultaneous events.

Success Factors

Once an opportunity was provided for students to construct a definition of mathematical success, students could then draw upon this definition to identify several factors which they perceived to have led to their success. A cross-case analysis (Miles & Huberman, 1994) was used to tease out success factors that were identified by students in four or more cases. What follows is a discussion of each of these factors in order of significance as follows: (a) Parental influence, (b) persevering despite challenges, (c) individual effort and hard work, (d) student-teacher interactions, (e) the relevance of mathematics, (f) the love of the discipline, (g) cultural influences, (h) strong mathematical backgrounds, (i) mathematics identities, (j) positive influences of race and racialized experiences, (k) good teaching and (l) peer interactions. The order of presentation of factors is based upon the fact that the first factors listed were discussed by all six participants, the next factors discussed by five participants and the factors towards the end of the list were discussed by only four participants (see Table 3 page 86).

Parental Influence

Across all six cases, participants discussed parents as a major factor which influenced their mathematical success at the community college. During the second individual interviews, information was gathered about parents' educational backgrounds. Tina and Ray were the only participants who were first generation college students. All other participants' parents held at least one Bachelor's degree while several held graduate degrees or had completed some graduate coursework. Charity was the only participant who had a parent with a Ph.D. Charity's father had a Ph.D and her mother had a Bachelor's. Adelle's parents both had Master's degrees and were currently pursuing their doctorates back in Nigeria. Although they were unable to finish due to financial reasons, both of Adrianna's parents had completed a considerable amount of graduate coursework towards their Master's degrees. James' mother earned a Bachelor's degree while his father earned two Bachelor's degrees.

Regardless of the educational background of the parents, all students described parents who had directly impacted their mathematical success in some way. For these students, parents consistently conveyed high expectations, while providing both encouragement and academic support along the way. In most cases, parents conveyed high expectations of academic success to students by keeping track of their grades and providing academic support when needed. These expectations motivated the participants to succeed and persist academically, so that they would not let their parents down. Ray describes how his mother expected nothing but the best from her children academically. Likewise, Adrianna's parents expected good grades from her and her brothers. The following quote by Adrianna summarizes how these high

expectations are conveyed to the participants and how it motivates them to succeed mathematically: “So, they [my parents] don’t stand for bad grades or anything like that, and I guess those expectations or goals that they have for us kinda rubs off a little bit and makes you wanna excel in everything; including math.” Similarly, Adelle is acutely aware of how important academic success is to her parents as they continue to speak with her regularly about her grades. Here, Adelle describes how their concern for her grades and high expectations motivated her to succeed academically:

My parents ask me about my grades. That’s definitely one big factor because I want to keep the grades high...not really because it’s a cool thing to do or anything but asking me about my grades makes me do better...My parents weren’t so strict and hard on me or anything, but they always wanted me to do well in school...I know they care about the grades.

As a result of such high expectations, many of the participants felt pressure to do well academically and make their parents proud. This pressure also seemed to serve as a motivational factor. The pressure to succeed academically appeared to be most evident in Adelle and Adrianna’s cases. Since her parents were financing her education and constantly asking about her grades, Adelle seemed pressured to meet their expectations.

Especially my Dad, my Dad almost cry if I do bad in math. Math is my Dad’s passion, but at the same time he’s not going to force it on me but he hopes so much that I do well in math that that’s been an inspiration. I

don't want to disappoint them and...they're not just sending me to school for fun you know, they're spending the money and hoping good results will come out of it.

Like Adelle's parents, Adrianna's parents continue to push her and her brothers to succeed both academically and mathematically. This pressure seemed to have a direct impact on her mathematical success at the college level.

...they definitely push myself and my two brothers to get good grades and to learn...my parents...they kind of pushed me hard to make sure that I would be...best at everything that I did and I know if I didn't have that kind of...pressure or support, then I might not have gotten as far in math as I did previously and so its...my influence from my parents I think [that] is important.

Tina felt similar pressure to do well academically as a first generation college student and the daughter of a mother who was a single parent. While talking about her mother and her role as a first generation college student, Tina stated the following: "...she never had a college education, and I want to make her proud. And she always said, kiddo, you know...you gotta be better than me, you know."

The educational levels of the parents also seemed to have a direct impact on each students' ability to succeed mathematically. Four of the six participants had parents who held college degrees. For many of them, this seemed to bring about a certain amount of social and cultural capital which contributed to their mathematical and overall academic success. For example, James refers to a math "gene" that he inherited from his parents who were both good at math. Their previous success with

the subject matter and rigorous mathematical backgrounds was perceived to have directly influenced his mathematical success at the college level.

I like to say that my math gene is probably inherited [be]cause both my parents were very good at math...I remember my mother telling me as a young person when she was taking math, they had essays and stuff like that in math tests. I think really, because of the fact that they [the math teachers] were tough on her and tough on them...on both my parents, it may have helped me...I definitely think it had a positive impact.

Working towards their doctorates, Adelle's parents were both academically and financially able to assist her in school. For example, Adelle's parents paid a tutor to work with her in math in grade six. Adelle's father also tutored her himself when he had the time. This gave her an advantage academically. The following quote demonstrates how this social/cultural capital aided her as she participated in mathematics: "They tried everything they could to help me do better. They got me a tutor. And when my dad had time...he taught me personally."

Regardless of the educational level of their parents, all students appeared to have been influenced in some way by one or both of their parents. This positive influence seemed to have directly impacted their mathematical success at the college level. In some cases, parents set high academic expectations which the participants felt pressure to achieve. In other cases, students benefited directly from the academic and financial support of their highly educated parents. Collectively, these parents' interest in their children's future also demonstrated a sense of caring. From a

sociocultural perspective, such interactions with parents helped to provide supportive environments whereby mathematical learning could occur. This seemingly contributed to their overall mathematical success.

Persevering Despite Challenges

Collectively, all students discussed challenges that they overcame throughout their schooling and participation in mathematics. Although most challenges were academic in nature, additional challenges included instances of racial discrimination and financial difficulty. Throughout the interviews, it became apparent that each participant exemplified a unique ability to overcome one challenge after another. This ability to overcome various challenges greatly impacted their mathematical success at the college level.

In order to better understand how the participants were able to achieve and maintain their mathematical success despite challenges, the following questions were asked during the first and second interviews:

1. What factors do you feel have helped you to persist (maintaining your success) in the study of mathematics?
2. What, if any, are the challenges that you feel have impacted your ability to succeed and persist in the study of mathematics? Discuss these challenges and how you may have managed to overcome them.
3. Whenever you came upon a difficult course or math concept in class, what types of things did you do to help you understand the course material?

Various answers to these questions revealed that these students collectively overcame financial, racial, and academic challenges. Their ability to overcome these challenges allowed them to persevere mathematically despite them.

For many of the participants, academic challenges included difficult math concepts, courses, or academic situations. For these students, hard work and perseverance allowed them to overcome these challenges and succeed within the discipline. For example, when James came across a difficult idea or math concept, he worked problems repeatedly until he was better able to understand the material. He states:

I'll look through my homework and find this problem in particular, work on those problems and work on not just one or two, but until I get the idea in my head. That includes stuff like the theorem[s] and the formulas and stuff like that.

Similarly, when challenged by advanced curricula in a high school mathematics course, Adelle chose to persevere while many of her classmates gave up and dropped out. She says:

We were actually 20 in the classroom. Toward the end of the year, we were just 7 because everybody dropped the class. They said it was too hard. I was actually proud of myself [that I didn't give up]...because it wasn't like I was really doing well. I was just doing averagely ok.

Like Adelle, Tina includes the practice of never giving up as part of her overall definition of mathematical success. This was demonstrated early in her college career when she was required to take a remedial course and later had to retake Pre-calculus

in order to complete her degree requirements. The following quote demonstrates how Tina perceives the connection between her ability to persevere through academic challenges and her success in mathematics:

The final week...I was sick...that took my grade down to a very high B. And you know what? It was the best B I ever got! That's success to me... the fact that I never gave up...what made me feel successful is that I did my remedial math and I took pre-calc and I failed...and I cried...and I didn't give up as much as I felt like I was the stupidest person on the face of the earth...So, what made me feel successful is the fact that I didn't give up.

Unlike Tina, Adrianna experienced perceived racial challenges which could have negatively impacted her ability to succeed mathematically. When perceived acts of discrimination from many of her professors became commonplace, Adrianna chose to work hard, prove them wrong, and move forward along the path to achieving her goals. She commented that,

...some of the challenges I had in math...were just lower expectations on behalf of professors about my ability to do well in math...One of the ways I overcome that challenge is just realizing this is what I want to do, so if that's the challenge that I have to overcome, then I have to do it. Just go, do the work and then prove people wrong, and then move forward along your goals...I feel every time that I go into a new math class that I have to kinda prove myself, that, oh, I know what I'm doing, or I understand the concepts...I have to do that above and beyond what some other classmates

have to do, and that's usually another reason why I try harder...to succeed in math.

All participants worked while attending college. Several students were partially or entirely responsible for paying for their own college tuition. For Tina and Ray who were first generation college students, financing their own education became an integral part of their college experience. This made it even more difficult for them to succeed. Likewise, as one of six children, Charity was motivated to do well academically so that money would not be wasted. Despite these financial challenges, all students were steadfast in achieving their goals. The following quote by Tina summarizes the impact of such financial challenges on these students mathematical and academic success at the college level.

I think it [finances] was a strain...on my academic performance, the amount of work I had to do...for the classes. And also, it was a mental strain of having...the expense of [not] having your tuition paid off while going to school. I think it's definitely a strain, rather than just going to school and not having to worry about expenses. Like now, I can do that at [the university] [be]cause I have a scholarship, so it's a lot better.

Collectively, these students demonstrated an ability to overcome a variety of challenges which allowed them to continue along the path towards achieving their goals. In this way, the ability to overcome challenges can be viewed as a success factor related to mathematical success.

Individual Effort and Hard Work

In this study, all students exemplified an ability to put forth individual effort and hard work in order to achieve their goals. As evidenced throughout the interviews, it was also apparent that the students perceived hard work to be a major factor contributing to their mathematical success and their ability to persevere. For example, most of the participants described long hours of studying as a necessary sacrifice to achieving and maintaining mathematical success. In some cases, additional work was required as students perceived cultural differences and/or a lack of social and cultural capital to put them at a disadvantage when compared to other students. Collectively, these students worked hard academically in order to maintain their success in mathematics.

Charity perceives herself to be a hard worker when it comes to academics and more specifically, mathematics. Throughout the interviews, she conveys the importance of doing her part in order to succeed. This consistent effort can be seen as directly attributable to her mathematical success at the college level.

I just see myself as a hard working student. I work hard in everything that I do. I just want to...come out as [the] best...I just try hard...math basically has been the same with every other subject, I would just work hard at it and I do that with every other subject.

Several of the participants discuss doing extra problems, reviewing material directly after class, and working through concepts over and over again until they can get it right. During the group interview, all students claimed that they studied every day or every other day in order to maintain their success in

math. The following quote by Adrianna summarizes the consistent individual effort put forth on behalf of these students to achieve and maintain this success:

I will definitely do extra homework or extra practice on that [difficult concept] to make sure I remember it...usually I'll look at it right after class...I try to do my homework right after I get out or usually no more than a day after I get out of class...if it stays fresh in my mind then I'm able to put pieces together.

Similarly, Ray worked for hours on weekends with an older student back in Jamaica to prepare for a high school mathematics exam. Later at CC1, he often stayed up late at night to gain a deeper understanding of difficult math concepts. While discussing the effort it took to be successful, Ray noted that,

...every Saturday, we would be at school doing math. There was nothing else, no other subject that would matter; it was just straight-up math. Math inside out, math from 8:00 in the morning to 6:00 in the afternoon. It was repetitive...that was a factor for me at a community college level where I didn't slack. I try to do whatever I can to get ahead. And sleepless nights? Yep, I did it.

Many of these students perceived cultural differences, and/or a lack of resources as additional challenges which required more work on their part. Although these were perceived as challenges, these students were motivated by them and worked hard despite this. In the quote below, Tina describes having to work harder than many of her peers who had highly educated parents.

But you know sometimes I look at kids that came...from backgrounds of parents who...are lawyers and doctors and professors and...I can tell the difference between them and me. I have to work at it and sweat at it. Not only would I sweat...I have to cry at it...I study for a week before an exam, they study two days and its fine by them...I may work 10 times harder than they do, you know.

Ray felt similar pressure to have to work harder as a student from the Caribbean who is also an African American. Since he was not born in the US, Ray considered himself to be a part of a “visiting team.” In his perception, this required that he work even harder. The following quote exemplifies these feelings:

...I think deep down inside there is some form of...prejudice in society, so being from a different country, a different place, you have to work extra harder...than the home team, I should say. The visiting team has to work harder than the home team at all times, no matter who, or where, or what you are. So yeah, I have to work double hard being African American and being from the Caribbean. That was my fuel to success I would say.

It was evident from the interviews that in order for the participants to achieve and maintain mathematical success, hard work was required. Despite many challenges, all students demonstrated the ability to put forth considerable effort to overcome these challenges. These efforts greatly contributed to their ability to succeed mathematically at the community college level.

Student-teacher Interactions

Evidence was provided across all six cases that positive student-teacher interactions were perceived by the students to directly influence their mathematical success. In several cases, faculty provided additional academic support outside of the classroom (office hours), mentorship, encouragement and guidance. In most cases, this additional support demonstrated a caring nature towards the students that seemed to have a direct impact on their ability to succeed mathematically. The best example of this was Ray's mentor-like relationship with his Calculus 1 teacher, Dr. Kendall. He provided Ray academic, financial, and emotional support which positively contributed to Ray's decision to persist in math. Even today, Professor Kendall continues to have a major impact on Ray's mathematical success. Although he did not specifically identify Professor Kendall as a mentor, Ray's description of their relationship suggests much more than just a typical student-teacher relationship. In addition to academic support, Dr. Kendall brought to the relationship encouragement, a caring nature, and a unique ability to understand Ray's experiences as an immigrant. An immigrant himself, Professor Kendall played an important role in Ray's mathematical success at both CC1 and the four-year institution where he currently attends.

...[Dr. Kendall] was there regardless of whatever situation it was, or whenever I saw him or asked a question...that was successful and that was good for me, to know that there was somebody who still cared...I was in a...upper-level math class, and you know, African American things were kind of difficult, especially asking questions and trying to get a full grasp

of that upper-level math. And then I would always refer to my first calc teacher [Dr. Kendall]...for...understanding.

The students noted that having math faculty who were approachable was extremely important to them in maintaining their mathematical success at the community college level. Ray even recalls receiving help from not only the math professors, but also the mathematics department chair when professors were not available. Likewise, both Adelle and Charity describe community college math faculty who were friendly and always available to answer their questions. This is summarized in the following quote as Adelle describes how her professors' willingness to answer her questions directly attributed to her mathematical success.

I also think my teachers have done a really good job because I was asking questions, and they were always willing to answer my questions. So I think that's another thing that helped me excel in math...The fact that they were approachable and easy to ask questions...was what really helped me [be]cause I knew that if something wasn't clear, I could always go back and ask questions and clarify.

In addition to academic support, many of the students described positive relationships with math faculty who were caring. In many instances they provided positive feedback and encouraged them to succeed. Tina discusses this as she describes her interaction with one of her math professors below.

...the teachers were very influential, because they always had a concern...even though when I did fail...Professor Mason's class...you

know what she said to me? She said, “You made me proud”. That’s what she said to me at the end of the final. She said, “You make me proud”.

Similarly, Charity describes the importance of having a good, caring teacher who makes you feel that you can be successful.

...if you have a good teacher, it makes you feel better in math...It’s easier to do your best at it and yet, if your teacher is bad, and...he doesn’t care, it makes you feel like, “Oh I can’t do this”. So, having good teachers...teachers that help you out, and that are approachable...really helps you...the teachers, they may give you...[the] courage to keep going.

Even though Adrianna did not experience positive relationships with her math professors, she describes a mentor-like relationship with her fourth grade math teacher who conveyed high expectations and believed in her abilities. As a result of this positive relationship, Adrianna developed a love of the discipline of mathematics which remained with her throughout her study of collegiate mathematics.

...I had one teacher who kind of took me under her wing in a sense. She...had high expectations of me and knew that I could do well even though maybe, in actuality, I couldn’t, but she worked me harder than maybe the other students. And that gave me the drive to not please her, but...rise up to those expectations...her pushing me and giving me the more advanced work to do, that kind of made me more interested in math and, I think, more successful in it.

Likewise, Ray describes the positive impact that non-math faculty had on his mathematical success as follows:

...there are instructors from other classes that [weren't] relatively math teachers, but actually did impact my studying [and] being successful in mathematics, because even in a physics class you have to know math. Being in an engineering class, you had to know mathematics. And they were always there.

Each participant in the study experienced positive interactions with caring teachers who offered both encouragement and academic support. In this way, positive interactions with faculty can be seen as a major factor contributing to these students' mathematical success.

The Relevance of Mathematics

Throughout the interviews, several participants acknowledged the relevance of mathematics in their lives. This was demonstrated as students discussed ways in which mathematics could be applied to their non-math courses, their jobs, and future careers. All careers chosen by the participants were those which directly involved the use of mathematical knowledge and understanding. These careers included becoming a doctor (Adelle and Tina), an economist (Adrianna), an engineer (Ray), an electrical technician (James), and an accountant (Charity).

Several students discussed the importance of mathematical knowledge and how it can be applied to other disciplines. As a future doctor, Tina was well aware of the need to know mathematics for use in her science coursework as she prepared for medical school. Tina's comments as follows, summarize how these students perceived mathematical knowledge to be applicable in other disciplines such as the sciences.

Because I'm taking analytical chem[istry]...it's all about reading and understanding...[and] doing the math. It's not a math class, but you still have to know how to...work out the molarity, change moles from different units; how do you do conversions...I want to take it [math] because...it's working into...my major. I mean, I'm not doing calc 3 level work, but there are a lot of things...physical chemistry...where you're doing integrals and all that stuff.

Throughout the study, several students also expressed the importance of mathematical knowledge acquisition as it related to their current and future career goals. Adelle acknowledges the importance of math to her future career as a doctor, while Adrianna sees math as directly applicable in her current job as a data analyst and future career as an economist. The following quote by Adrianna summarizes how these students perceived mathematics to be applicable to various jobs and careers.

...my job is more like analyzing the data for a research that they're doing, and trying to see if it's accurate to the standards that they've set out basically...So, what I'm doing is...taking that data, looking at it, standardizing it, putting it [in]to SPSS [a statistical program]...What I hope to do is go to grad[uate] school for the academic year after this for economics, because my dream job is to be an international economist for a non-profit or non-governmental organization...and that would definitely be math involved in that.

Although several students implied that mathematics was highly relevant, Tina was the only participant who spoke specifically of the relevance of mathematics to her every day life outside of college and career. The following quote exemplifies how Tina perceives the importance of mathematical knowledge in everyone's lives:

...and realizing that math is just not some made-up number, equation...from...[some] crazy mathematician made up at the side of the room; it's what we live, everything we do. We go to the grocery store...it's what it is. It's a part of us.

In these ways, the relevance of mathematical knowledge and understanding to each of the participant's lives, coursework and careers can be seen as a major motivational factor directly contributing to their overall mathematical success.

The Love of the Discipline

All six participants indicated a genuine love of the discipline of mathematics which seemed to directly impact their mathematical success at the community college level. In most cases, students began to prefer math over other subjects as they became more competent in this area.

Charity, Adelle, and James began liking mathematics during their elementary years. James revealed that he currently likes mathematics and had enjoyed studying the discipline as early as third or fourth grade. Adelle and Charity began liking math in sixth grade as they became more successful in it. An underlying theme throughout the data was a love of mathematics which generally emerged as students became more mathematically successful. This theme will be discussed in more detail in chapter 5.

Ray developed a love of math while spending his Saturdays working with another student in preparation for a high school exit exam. As he became more successful, Ray began to appreciate certain aspects of the discipline. The following quote (previously used) also illustrates how this love of the discipline developed as he became more successful in mathematics:

...I grew the love for math, and I think after that, that's when I was hypnotized, I was brainwashed that [math]...was the only real subject ever taught in school, because there was never a wrong answer...never an in-between answer...It was always right or wrong, unlike a couple subjects that I've been [in] where it was up to the instructor to decide whether it was correct or not. But math, you get it correct or not correct, and that's when I learned to appreciate it. That was the only thing that made sense to me as a subject in school. And that's when I think I grew successful in mathematics.

Because she is good at it, Adrianna also prefers math over other subjects such as speaking and writing. This motivates her to focus more attention on learning math. In the following quote, Adrianna compares mathematics to other subjects and describes characteristics of the discipline that she enjoys:

Well, another factor is that I like math better than writing, and that always makes me wanna do math more than any other class...a way of thinking, for me, is...[things are] easier to do with numbers...than it is with words...that's always been the way that I was when I was even a little kid, that I could memorize numbers and all that, but I can't really speak that

well. I can see...pictures, but I can't really...verbalize things very well, so math has always been a lot easier for me to do than anything else. And that was a factor in me being interested in it and also wanting to do well in it...so I focused on math a lot more because of that.

Lastly, Tina who always liked math, enjoys the subject because it builds on previous topics. Although it is not required for her major, she describes math as a somewhat of a passion and expressed a desire to learn more. The following quote conveys Tina's love of the subject:

And that's one of the things I love with math; it's like you're building a house. You know, you start with the foundation, you start with the steel and...you're just throwing things in and you're building...and I loved it. I loved doing it. It's so funny that...it's not a part of my nature, it's [math is] not a part of my passion. It's like something fun for me to do. It is somewhat of a passion, but not as much as chemistry, biochemistry and biology...I think calc[ulus] 1 was my requirement...and I went on to calc[ulus] 2 because I ...was curious. I wanted to know, okay, what's more? I'm even thinking of taking calc[ulus] 3 in the summer. I want to know what's more...what's going on?

Across all cases, students presented a genuine love of the discipline of mathematics which began early on and developed as students became mathematically successful. As a result, the love of mathematics as a discipline was perceived by students to be a major factor attributable to their mathematical success.

Cultural Influences

All of the participants in the current study had ties to non-American cultures. Charity, Adrianna, and Tina self-identified as Black or African American but described cultural influences based on relationships with immediate and/or extended family members born in Nigeria, Puerto Rico, and Trinidad respectively. Both James and Ray referenced Caribbean ties while Adelle identified as Black or African American of African (Nigerian) descent. Across all cases, participants described aspects of their own or their family's culture which seemingly impacted their mathematical success in a positive way.

For Tina, race was not a huge issue for her as a Trinidadian. According to Tina, Trinidadian culture does not focus on race. For this reason, Tina was only slightly disappointed, but not highly concerned with being the only Black student in a predominantly White environment. Her ability to not focus entirely on her race may have indirectly contributed to her mathematical success at a predominantly White institution. Similarly, when asked how coming from a different culture may have directly impacted her mathematical success, Tina describes feeling competitive as a student from another country and how this motivates her to become a better student of mathematics. This also appeared to be the case with Ray who repeatedly described a responsibility to do well academically as a person coming from and representing the Caribbean. Collectively, these common perceptions of the Caribbean participants may have positively contributed to these students' mathematical success at CC1. Tina's

quote below summarizes the positive effects of being a Caribbean immigrant on her academic experiences at CC1.

I've been in a lot of places where I'm the only Black person, and I don't care about it. I'm just happy to be where I am. What I care about is that I am doing what I came here to do...I was able to develop better studying skills and habits [and] I was able to understand math I think a lot better because here I was in a new country; I have to be competitive, I have to understand...what I was doing.

An underlying theme amongst the students with ties to Caribbean cultures (Ray, Tina, and Adrianna) was also a desire to give back to their families and communities. This desire to give back to others served as a strong motivational factor as students strived to acquire the additional mathematical knowledge necessary to meet this goal. Both Tina and Ray clearly identify this desire to give back as a factor directly related to their individual mathematical success. Ray specifically attributes his desire to give back as a motivational factor, and defines his success by his ability to one day accomplish this goal. In the quote below, Ray describes his desire to one day return to his home country of Jamaica and teach mathematics to others.

I guess one of my passions right now is going back and giving back to my high school that I graduated from. I mean, that would be a factor that would probably influence my success more. Giving back to the college or the high school that actually [gave] me the start, because if it wasn't being there at that school at that particular time in my life, I probably wouldn't

feel the urge of loving math or practicing math...So I guess that's the only factor, of giving back to that school...[it] still impacts me to be good at what I do, because if I continue to be good at what I do, one day I can go back there...that's where I would draw the line of being successful...I think my biggest achievement or my biggest goal after doing all this math is to know that I've impacted a lot of people...and if I can continue to do that...I'm successful.

As a first generation college student, Tina also desires to bring mathematical knowledge back to her family now, and in future generations. She states:

I am the first person in my family to ever go to college...and my family don't even know that there's something called...calculus but they're not mathematically inclined. So for me...it was, hey, someone has to know about it, to tell the others. So basically that's what it was. You know? You can't have a whole generation going down, not knowing or being ignorant to...a lot of things that we do have access to in the world. So for me that would be a personal factor...I don't want to look back at my life you know 10, 30 years from now and not feel like I haven't accomplished anything or feel like if I have a kid I can't be able to teach my kid something...[if] my kid come[s] home with a math problem, I want to be able to say ok, I haven't done this in a while but let's go through it together.

Similarly, Adrianna's career choice to be an economist for a non-government or non-profit organization represents her commitment to giving back to her family

and community. Adrianna wants to give to others and is motivated to acquire additional mathematical knowledge in order to make this possible. As the granddaughter of a Puerto Rican, this could also be the result of Caribbean cultural influences and beliefs.

...you kind of understand the importance of it all when your parents are there saying...you need to do well in school so you can do this after school and that you can be successful and maybe help out your own family; so it kind of acts as motivation for me.

Lastly, it should also be noted that Caribbean immigrants, Tina and Ray were both members and president of the Caribbean Student Association (CSA) at CC1. The CSA is a student organization which provides Caribbean students with academic and social activities designed to help support them within the community college environment. As president of the association, Tina describes how student members brought various issues to the attention of the association's leadership on a regular basis. Such issues included problems with professors and instances of perceived racism. As understood by Tina's description, this organization provided a social outlet, practical advice and academic support for these students who may have experienced unique difficulties as racial and cultural minorities within a predominantly White environment. Since both Caribbean immigrants in the study were actively involved in this association, it is possible that these students' participation in this organization positively contributed to their mathematical and academic success at CC1. This finding will be discussed further in chapter 5.

With ties to Nigeria, Charity and Adelle discuss their perceptions of Nigerian culture including how Nigerian parents are strict when it comes to grades. Not wanting to disappoint their parents, both Charity and Adelle were highly motivated to succeed in mathematics as well as their other courses. Adelle reflected upon these issues in the following way.

I do not want to generalize too much, but I think cause I'm from Nigeria, Nigerian parents...they really care much about the grades and my parents are so strict that ...they're so particular about success in school. My parents weren't so strict and hard on me or anything, but they always wanted me to do well in school...I don't want to disappoint them and I know they care about the grades.

Having spent time in Nigeria, Charity was also motivated to take advantage of the vast educational opportunities here in the US. She identified with being a second generation immigrant and was aware that education does not always come so easily back in Nigeria. This connection to her family's country and culture seemed to serve as a motivational factor attributable to her success in mathematics.

I lived in Nigeria for a couple of years. And the students there, they don't have much, but they still strive, and do their best, and put all their effort...when it comes to education they're very, very serious when it comes to things like that. And so, I guess seeing the impact, seeing the way America has everything just a lot more easier coming towards them, and Nigeria is the opposite, it makes you be grateful for what you have,

and to just see that you have all these chances, why not use them? Why just waste them? Just leave them there.

Cultural differences between mathematics and educational curricula in their home countries and here in the US may have uniquely prepared these students for mathematical success in this country. Although James was a second generation immigrant, he was aware of various cultural influences from the Caribbean conveyed through his parents. Although unsure about the impact these cultural influences had on his mathematical success, James is convinced it was not negative. Born in the US, James' parents immigrated from Bonaire and St. Lucia. They both describe having difficult mathematics curricula and coursework which may have indirectly encouraged him to strive for personal success. The following quote by James summarizes this:

The school system in the Caribbean is a lot different and a lot more difficult than it is up here. I remember my mother telling me as a young person when she was taking math, they had essays and stuff like that in math tests. I think really, because of the fact that they were tough on her and tough on them, on both my parents, it may have helped me. Exactly how, I'm not sure, but I definitely think it had a positive impact.

Similarly, Adelle describes coursework in Nigeria as much more difficult than coursework in the US. Having only been in the country since 2005, Adelle's educational experiences in Nigeria are recent. She describes Nigerian teachers as strict instructors who set high expectations which the students consistently strive to

meet. As described below, this may have adequately prepared her for mathematical success here in the states.

Well, I'm not really sure if this is cultural, but most schools in Nigeria teach math... a little differently. There's a lot of memorization, and...the teachers are really strict...They give us tests, and they also give us a range...that they want. They tell you, okay, this test is over 20 [and] you're supposed to get between 15 and 20. They were very strict about it...[and] that made us really work ourselves...to...be able to meet up with that expectation.

Tina also describes a rigorous British system of teaching mathematics in Trinidad, an emphasis on Algebra and a lack of calculator use there. This rigorous curriculum may have also given her a cultural advantage mathematically.

[In] my country, there's no calculator. Division was done long division [and] you had to know how to do long, short, and it was done on pen and paper...even now if you go back the elementary school kids, they're using their brain, they're using the pen...pencil, counting on fingers [and] counting on blocks. Here it's so easy to plug and chug, even young kids [are] using calculators, they're using their computer, their using watches, their using their phone...I think elementary school [back in Trinidad] allowed me...to...articulate with counting in my head...I came across people...who are citizens here in the math tutoring lab and Algebra seems to be the hardest thing for them to understand. I thought Algebra was the

easiest thing...again, maybe because the British focus more on Algebra...[and] Trig and that's the type of math that I learned.

As presented here, cultural influences from either African or Caribbean cultures seemed to positively impact each student's mathematical success in some way.

Strong Mathematical Backgrounds

Across all cases there was evidence of a strong, pre-college background in mathematics coursework at the elementary, middle and high school levels. All participants perceived this strong mathematical background to help contribute to their success in mathematics at the college level. The impact of pre-college mathematical coursework was evident even though interview questions focused primarily on collegiate mathematical experiences.

Although participants varied in their earlier educational experiences, all students perceived their pre-college mathematics coursework to be adequate preparation for the study of college-level mathematics. This was even the case among those who were required to take a remedial mathematics course. Likewise, it also became apparent that several of the participants perceived there to be a connection between mathematical topics presented in high school and topics that were later covered in their college math courses.

Tina, Charity, and James did not score high enough on the mathematics placement exam at CC1 and were required to take a developmental course (Intermediate Algebra) before they could enroll in credit-level math. Despite having to enroll in a developmental class, these students perceived their pre-

college math coursework to be adequate preparation for college-level math. The following statement by Charity summarizes how most of the participants felt about their mathematics preparation: “I...think my teachers that I’ve had through elementary, and middle school, and high school, and the classes I took, and the kind of stuff that I learned really prepared me for the college-level math.”

Likewise, Tina frequently refers to a strong algebraic background that she received studying math in Trinidad. She describes an educational system providing minimal use of the calculator and a focus on algebra. According to Tina, this strong algebraic background served her well at the college level. She states, “I think if I didn’t have such a strong algebra[ic] background, it probably would have been harder for me to get a lot of things [in college].”

More specifically, several of the participants discussed advanced mathematical topics that they studied at the high school level which helped to prepare them for college math study. Adrianna was the only participant who participated in a talented and gifted program prior to college. Beginning in middle school, this program granted Adrianna access to advanced mathematics courses and topics. Similarly, James was exposed to Algebra, Geometry, Algebra II and Pre-calculus courses in high school. Adelle was even exposed to calculus topics in an optional high school math course taken in Nigeria. Both Adelle and James perceived a strong connection between their exposure to advanced math topics and their subsequent success in their college math courses. Adelle’s comments below illustrate how these participants perceived their exposure to advanced coursework to directly impact their mathematical success at the college level.

I took an optional math when I was at high school. We called it further math, but it had differential calculus in it. It also had a little bit of integral calculus...and then we did some topics like partial fractions. I think that's considered pre-calculus. So I think that helped a lot. And as I took Calculus 1 [in college], a lot of things looked familiar to me, even though they were not too clear. I didn't do too good in that class, but...I was able to recognize some...[math] topics as we treated them in college.

Although the participants in this study experienced a variety of mathematical experiences prior to college, all students perceived themselves to have a strong mathematical background which directly contributed to their mathematical success at the community college level.

Mathematics Identities

During the data collection process, two questions were posed to students in order to better understand each student's perception of him or herself as a student of mathematics and a mathematics performer. This question was informed by D. Martin's (2006) definition of mathematics identity as a collection of individually developed beliefs and dispositions included in one's self-concept, regarding their own perception of their ability to do mathematics. These beliefs include "(a) their ability to perform in mathematical contexts, (b) the instrumental importance of mathematical knowledge, (c) constraints and opportunities in mathematical contexts, and (d) the resulting motivations and strategies used to obtain mathematics knowledge" (D. Martin, 2000, p. 19). These individualized beliefs regarding a student's perception of their mathematical ability can also be informed by how others perceive the student as

a “doer” of mathematics or mathematics performer (D. Martin, 2006). From a sociocultural perspective, I propose that mathematics identities are informed by social interactions with others through a process of socialization. This is consistent with ideas discussed by D. Martin (2000), who states that “mathematics socialization describes the processes and experiences by which individual and collective mathematics identities are shaped in sociohistorical, community, school and intrapersonal contexts” (D. Martin, 2000, p. 19). It is this perspective that was used to analyze the students’ responses to the following questions in the demographic questionnaire and interview respectively:

1. How do you think you are doing in your current mathematics course?
2. Overall, how do you currently see yourself as a student and “doer” of mathematics?

Based on the previously stated definition, all participants seemed to have an overall positive mathematics identity. Adrianna perceived herself to have performed “good” overall in her mathematics courses at CC2. This positive math identity may have been informed by her current success using mathematical knowledge on the job. Among all the participants in the study, Adrianna was the only participant who was currently working at a full-time job where mathematics was directly applicable. In her current position, Adrianna was responsible for analyzing data.

Adrianna’s mathematics identity was so positive that negative interactions with math teachers and professors did not lead her to believe that she was not capable of doing mathematics. This was evidenced as she consistently challenged professors

who held negative perceptions about her ability as a mathematics student. Despite these challenges, Adrianna seemed to maintain a positive mathematics identity throughout her schooling. This identity may also have been informed by her fourth grade math teacher who held high expectations for Adrianna and encouraged her along the way. Adrianna seemed to repeatedly draw upon these aspects of a positive mathematics identity in order to prove her doubting professors wrong. The following quote demonstrates Adrianna's confidence in her mathematical success and her ability to perform mathematically:

...getting good grades in the class was definitely one sign that I took as being successful, but also...getting the handle on concepts a little quicker than others and being able to understand what was called difficult...just to understand it and to have it click in my mind a little bit faster than others...that's when I knew.

Like Adrianna, Adelle sees herself as a competent performer of mathematics. She describes mathematics as something she can do as long as she puts her mind to it. Adelle's positive mathematics identity appears to be informed through positive interactions with others such as peers in the math tutoring lab. During these interactions, she shares her mathematical knowledge with others. These opportunities to share mathematical knowledge positively contribute to her mathematics identity and subsequently, her mathematical success. In the following quote, Adelle describes how she feels about her ability to do math successfully:

I see math as something...that I can do. Because before, I never looked at math as something that could be so easy. Even though my dad told me

math was easy, I just thought he was saying that because he was good in math. But now I see that math is something that I can do, as long as I put my mind to it. And another thing that's helping me...even in other subjects, is I tend to...share what I know. And that brings back what I've learned already. And I share what I know with other people, in classes, or students I tutor.

Charity was the only participant who perceived her performance in mathematics courses to be “excellent,” suggesting a highly positive mathematics identity. This was also informed by the high grades she received in her classes. She states, “...getting good grades, at that point, made me feel successful. When you get an ‘A’ on every single test, then...it makes you feel that you did your best...and then you can really do it.”

Although the mathematics identities of the participants were mostly positive, several of the students provided evidence suggesting that their identities were evolving. James describes his performance in his college mathematics courses as “good” and perceives himself to have inherited a math gene from his parents. He is clear to indicate that his ability to do well in mathematics is not a direct result of anything that his teacher or anyone else has done, but his inherited math ability. He later goes on to provide additional insight into how he sees himself as a student of mathematics. He further admits to being only somewhat successful in math and needing additional help at times. The following quote shows both aspects of his mathematics identity:

I like to say that my math gene is probably inherited cause both my parents were very good at math, but there was nothing really...no teacher or anything that really helped me build on my math skills, really, in high school...I would like to think of myself as somewhat successful at it...I wouldn't say I'm a math genius but at the same time, I don't struggle with it. I do understand it and at times...it does get a little difficult and I do need help. I'm not a math perfectionist, no.

It is evident that James is continuing to negotiate his perception of himself as a mathematics performer, while maintaining an overall positive identity as a mathematics student.

Describing her performance in her mathematics courses as “very good,” Tina perceives herself to be a stable mathematics student but not always the best. Despite evidence consistent of both a competent and non-competent performer, Tina seems to maintain an overall positive mathematics identity. It is highly possible that Tina's positive mathematics identity was informed by her mentor, Uncle Dirk, who constantly encouraged and supported her by telling her that she can do math. These positive interactions with her mentor may have provided additional opportunities for a positive mathematics identity to evolve. The following quote exemplifies Tina's perception of herself as a student of mathematics:

...the way math goes for me...if you ask me something now

I...probably...would understand what you're saying. It might take a while

but if you give me a textbook...I'll go through it and it will click. Like it clicks for me and...that's how I learned math.

The ever-changing nature of Ray's mathematics identity is also evident as he perceives himself to be both successful and not successful as a mathematics student. Although he considers his performance in his mathematics courses to be "very good," at times he does not consider himself mathematically successful.

...I can't say I'm that successful in mathematics, but I've accomplished a lot and based on my accomplishment compared to other students, I mean, it's successful...I know I'm good at what I do but I may not be better than the next person...I see myself as an average joe...and that's about it.

Collectively, the data gathered from the questionnaires and interviews suggests that although some identities were evolving, each participant described aspects of a positive mathematics identity which seemingly contributed to their mathematical success.

Positive Influences of Race and Racialized Experiences

According to D. Martin (2000), one's mathematics identity strongly parallels one's racial identity. From a sociocultural perspective, an individual's racial identity can be informed through social interactions with others. In this way, one's racial identity may evolve simultaneously and in a similar manner as one's mathematics identity. Although examining the development of these students' racial identities was beyond the scope of this dissertation, a connection between these students' racialized experiences, mathematics identities and their subsequent success in mathematics was apparent across several cases. For a majority of these students, race appeared to play a

major role in their mathematical and overall academic success at the community college level.

For Adrianna, her mathematics identity was not entirely divorced from the racialized experiences she encountered as a college student. In her perception, college mathematics faculty held low expectations of her because she was African American. This most likely worked to affect her negatively as an African American student who was not perceived by others to be good at mathematics. Adrianna worked diligently to prove otherwise demonstrating mathematical knowledge and understanding despite perceived low expectations of her race. The following quote illustrates how Adrianna attempted to create a more positive association between African Americans and mathematics:

...a lot of times teachers would underestimate me and...automatically think that I'm least able in the class...the only difference between me and the other person would be because I'm Black, but that's how I felt about it sometimes. They underestimated me and therefore I had to keep proving to them that I was smart and that also Black people can be smart.

Similar to Adrianna's desire to prove her professors wrong, several of the participants felt a need to represent positively for their race amongst their peers and classmates. Originally from the Caribbean, both Tina and Ray conveyed a desire to represent for the race as they strove to succeed mathematically despite negative racial stereotypes generally associated with Blacks or African Americans. Such negative stereotypes are often placed inadvertently on Caribbean and African immigrants who are perceived to share physical characteristics with

Black Americans (Rong & Brown, 2002). Tina, for example, felt a need to perform well mathematically and wanted to represent herself positively as the only Black female in a Calculus 2 class. Similarly, Adrianna felt the need to represent for her race by demonstrating mathematical knowledge to her doubting professors and non-black peers. The following quote by Adrianna summarizes the responsibility that these students felt as one of few African American students in their mathematics classes:

...being in math class, usually you'd be like...one of two Black people there and [I] felt the responsibility of having to be like the representative of all Black people and all Black knowledge...like if you do something wrong then it's like oh, the whole race is hurting because I've answered that question wrong but...it kind of made you want to work a little bit harder so you didn't... reflect badly on everybody else or...you don't want people to be saying oh well, you know why she didn't get that right, [be]cause she was Black.

Collectively, Ray, Tina and Adrianna also felt the need to perform well in mathematics as a representative of the African American race. This suggests that they held previous beliefs informed by negative perceptions regarding African Americans as people who are not successful in mathematics. Despite these negative beliefs, these students actively chose to pursue mathematical success. In Ray's case, this also included helping other African American students to become mathematically successful. These behaviors perhaps contributed to a more positive association

between his race and the study of mathematics. The following quote represents Ray's feeling of racial responsibility towards other African American students:

I feel like it's my job to help other African American students, especially not being racist, not being stereotyped, but being the fact that I've been there, know the experience, [it] drives me...to know that I have to stay on top of my game...so I can help somebody else feel comfortable.

Although they are originally from the Caribbean, both Ray and Tina drew upon a racial identification with African Americans to accomplish something which they and other African Americans could be proud of. This individual agency allowed them the opportunity positively represent their race. The following quote by Tina exemplifies the importance of this sense of responsibility in their lives:

I know you can't change...how a certain people view you and I don't intend to so...when I become a doctor, I want to represent all the people that look like me, that think like me...the people that...have been through everything that I've been through and if I do come up to someone one day who is a racist, and...they feel a need to remind me that...the color of my skin is darker than theirs is...I'm going to feel good about all my success through math and through everything that I've done in life because...if that person feels the need to remind me who I am than that is a good thing...That's not a bad thing for me at all because every day that I achieve my goal and I achieve my dream, that reminds me of who I am

and that reminds me of the people that want to achieve the goal or the people that doesn't have the opportunity to.

Although racialized experiences and issues of race appeared to influence student success in most cases, several students perceived there to be a minimal impact of race on their mathematical success. For James, oppositional experiences and early exposure to mathematically successful African American peers provided positive role models and a positive association between African Americans and mathematics. These role models challenged notions of inferiority among African Americans in the areas of mathematical study and participation. As a result, James did not perceive race to directly contribute to his mathematical success negatively or positively. In his perception, negative or even positive feelings about race are nonexistent and therefore do not directly impact his mathematical success. The following quote exemplifies his feelings about the role of race and mathematical success:

I came in there, already good at math. Race has nothing to do with it. It didn't motivate me, it didn't take away from me... Meaning the fact that there were a wide variety of African Americans doing well [in my earlier schooling]... I don't think... it had anything to do with race really... I didn't let something like that impact how well I do in math... I was good in math coming into that situation, it was nothing that they did and I would hope that it would have nothing to do with race to begin with, honestly.

Likewise, Charity did not discuss race directly, but described feeling more comfortable in a predominantly White mathematics classroom or more diverse classroom than a predominantly Black environment such as an HBCU (Historically

Black College or University). Attempts to probe into this idea further did not reveal much as Charity did not seem open to discussing issues of race. This suggests that Charity placed little or no emphasis on race and did not perceive race to influence her mathematical success in any way. Culturally, this may be a result of her strong ties to Nigeria where race is not such a major focus. This is evidenced when Charity was asked to describe how she sees herself as an African American student of mathematics. She answered, “I just see myself as another person trying their best to do what they can, to make a good living for themselves in the future”.

Race did not appear to play a major role in Adelle’s mathematical success either. During the interviews, Adelle would often defer to discussing her Nigerian culture whenever the topic of race came up. This lack of race as a salient factor is consistent with Charity’s perception of race. In both Charity and Adelle’s cases, race or racial experiences did not seem to play a major role in their individual mathematical success at the college level. For a majority of the participants however, evidence did suggest that race and racialized experiences played a major part in these students’ mathematical success.

Good Teaching

Several students described characteristics of mathematics teaching which they perceived to positively attribute to their success. Participants noted high expectations conveyed by the faculty, an enthusiasm for teaching, and disciplined classrooms which provided positive environments for learning. Tina’s description of Professor Damon demonstrates several attributes of the teachers and their teaching that these students found conducive to learning mathematics at the community college level.

...he's [Professor Damon is] very old school, very disciplined, and I like that a lot. It helped me to focus because here I am, sitting in class thinking, this is a guy who doesn't expect anything less...it's just this whole personality and character behind...delivering the knowledge of what he has to give us, that is really interesting and made learning calc[ulus] 2 even more interesting...and knowing that you can go there and he wouldn't spoon feed...you.

Charity, James, and Adelle describe the importance of having knowledgeable, approachable teachers who demonstrated a caring nature towards the students. Having good teachers who demonstrated these qualities motivated them to succeed mathematically. Charity's quote (previously used) also summarizes the impact of good teaching.

...if you have a good teacher, it makes you feel better in math...It's easier to do your best at it and yet, if your teacher is bad, and...he doesn't care, it makes you feel like, "Oh I can't do this;" so having good teachers, teachers that help you out and that are approachable...really helps you...it's very important to have...a teacher that really cares and shows that to the students.

Peer Interactions

In a community college setting, student ages can range from the traditional college freshman at 18 to students well into their 60's. For this reason, peers will refer to students who may be younger or older than the participants, but are concurrently enrolled in college courses.

As evidenced among several cases, peer interactions provided opportunities for students to acquire additional mathematical knowledge while developing a deeper understanding of mathematical concepts. For the purposes of this dissertation, these interactions will include mathematical participation with peers both inside and outside of the classroom environment.

Although Adrianna did not study extensively with peers at the college level, she often consulted with peers regularly for advice and guidance. Studying with a peer in high school helped her to succeed mathematically as both students shared their knowledge with each other. Below is Adrianna's description of a peer interaction which represents the types of mathematical participation that generally occurred as these participants studied with their peers.

...we would get together, and try to do the homework, and work it out...when we worked together, we...brainstormed about how to approach a problem. You know, throwing out ideas about what is the first step, what's the next step, and especially if we didn't understand it. We would do trial and error. Like, "Oh, how about we try doing this first, doing that first?" We try it. If that doesn't work, then she would say, "How about we do this?" And that way, we would not only try and figure it out ourselves, in a sense, but it would help us memorize the material even more by explaining it verbally to each other, and having to defend, in a sense, your idea of how to approach a problem.

Four of the six participants described similar positive peer interactions occurring primarily with students in the math tutoring lab at CC1. As a result of

these interactions, several students identified the math tutoring lab as a major success factor. This facility provided various opportunities for learning through teaching and tutoring by both peer tutors and faculty. On a walk-in basis, students may ask for help with their coursework or homework. According to Adrianna, a similar facility is also available for students on CC2's campus.

For the participants in this study, the tutoring lab was used primarily for help with math homework. Participants described positive interactions with tutors and peers in the math lab which greatly contributed to their overall mathematical success. In several cases, students described invaluable teaching opportunities with peers as they tutored others in this environment. These students seemed to benefit mathematically as they shared mathematical knowledge with others. For example, Tina describes how she truly benefited from being able to help other students informally in the lab when someone had a question. As a paid peer tutor, Adelle describes how tutoring provided additional opportunities for her to review math concepts and apply them to her current mathematics coursework. Similarly, Ray described tutoring as motivational, prompting him to “stay on top of his game” so that he could help other students. Below, Adelle summarizes how tutoring others may have attributed to her own mathematical success.

It has helped me apply the concepts I have learned. I didn't just learn them and sit and forget about them, but I had to use them almost every day because I have people that I pass the knowledge on to and things that are not clear to me. I actually go back to the book and make sure that I get it straight. So I think that has been a major, major part...peer tutoring has

helped me remember the things I have learned from Calculus 1, so I applied that and that...prepared me for Calculus 2.

Students also experienced positive interactions with peer tutors who assisted them when help was needed. These interactions seemed to motivate and support them academically, subsequently contributing to their mathematical success. In the following quote, Adelle describes the impact that her peer tutors had on her success in mathematics.

One thing that I thought that really helped me do well in math here was the math lab...the people at the math lab were really helpful...they would sit beside me and made sure that I got everything clearly. And I actually became a math tutor because they inspired me...the peer tutors inspired me [be]cause of the way they gave me a lot of attention.

Several students discussed peer interactions outside of the math lab which provided not only academic, but emotional support as well. Aside from being able to study mathematics with their peers, classmates were sources of support that these students could turn to in order to discuss grades and other academic issues. Below, Adelle describes both the academic and emotional support provided through these more informal peer interactions, which allowed her to persist throughout her coursework.

...during Calculus 1, there was one of my classmates that I used to study with. I used to do homework together and practice questions together. So that really helped, because if it was just me, I would probably not be able to cover that much work, or feel tired, and just lose it, where the fact that

there was somebody else...who was doing the same thing as I was, that gave me some encouragement and motivation...a lot of us were looking out for each other. “Hey, how are you doing in the class?” And that really helps, because knowing that there’s some people that care about my grades, and that I was free to tell them. I mean...even if I didn’t do well, I wasn’t shying away from telling them. That also helped.

Although few students discussed studying in groups at the college level, Ray perceived studying with a study group during a Differential Equations class to be helpful. Below, Ray describes positive interactions studying with his peers and how they played a major role in his mathematical success at the community college.

I guess my classmates [helped] [be]cause I had to...prove to them, myself, that I...could do this so...we all get together and...work as a team so, I guess I would say my success at the community college level would be the instructor and all my math classmates...cause most of them was really helpful.

Although instances of group study outside of the math lab were infrequent, most students experienced positive benefits from interactions with peers in both high school and college. These interactions greatly impacted their mathematical success at the community college level.

Collectively, when asked about factors impacting or influencing their mathematical success, these students perceived the previously discussed factors to have the greatest impact on their mathematical success at the community college level. In many ways, these factors worked to motivate, support and sustain these

students throughout their study of mathematics. For example, disciplinary factors such as having a genuine love of the discipline, motivated students to actively participate and acquire additional mathematical knowledge. Similarly, support structures such as caring mathematics faculty and parents helped to equip these students with the tools necessary to achieve and maintain their success. Lastly, personal factors such as the ability to persevere made it possible for these students to succeed mathematically in a community college setting. Chapter 5 follows with a more in depth discussion of these factors and how they were perceived by the students to directly impact their mathematical success at the community college level.

CHAPTER 5: FINDINGS, DISCUSSION, CONCLUSIONS AND LIMITATIONS

The purpose of this study was to examine Black or African American students' perceptions of mathematical success, to identify mathematical success factors as these students' perceived them and to better understand how the students perceived these success factors to directly impact or influence their mathematical success at the community college level. In an effort to better understand these issues, a qualitative methodology was used involving a multiple case study design. Through interviewing as the primary method of data collection, I sought to answer the following research questions:

1. How do mathematically successful, Black/African American students define mathematical success?
2. What are the factors (e.g., sociocultural, institutional, personal and disciplinary) that mathematically successful Black/African American students identify as directly impacting their mathematical success within a community college environment?
 - 2a. What are Black/African American students' perceptions of the relationship between these factors (e.g., sociocultural, institutional, personal and disciplinary) and their individual mathematical success at the community college level?

Data was collected through a series of two individual interviews, a group interview, a preliminary questionnaire, and a review of student records and transcripts. The sample consisted of six participants who were chosen based upon pre-determined criteria and their availability to participate in the study. The final

sample included four females and two male students who currently or recently attended one of two community colleges within the state of Maryland. Five students attended Community College One (CC1) and one student attended Community College Two (CC2). Students selected for the study had taken at least two, credit-bearing mathematics courses at the college level including at least one Calculus course. All students had received grades of A's or B's in several of these courses and came recommended by their mathematics professors.

The chapter begins with a discussion of the students' definitions of mathematical success. Following is a discussion around the identified success factors and how they seem to directly impact these students mathematical success within the context of a community college. These factors will be discussed within three major themes: disciplinary factors, support systems, and personal factors. The discussions will include how the students perceived these factors to relate to their mathematical success. Throughout each discussion, findings will be compared and contrasted to results of previously conducted studies and assumptions found within the literature. Following a discussion of the factors, I will discuss the impact of the study's limitations.

Findings

This study's findings indicate that a majority of the participants perceived mathematical success to encompass understanding mathematical content, getting good grades and liking mathematics as a discipline. Working within the framework of this definition, students identified various factors that they perceived to directly impact or influence their mathematical success at the community college level.

Interview data revealed that four or more participants perceived liking mathematics, parental influences, perseverance despite challenges, individual effort and hard work, positive student-teacher interactions, the relevance of mathematics, cultural influences, strong mathematical backgrounds, positive mathematics identities, positive influences of race, good teaching, and positive peer interactions to directly contribute to their mathematical success. The following is a discussion of all of these findings.

Defining Mathematical Success

The majority of the participants in this study defined mathematical success as understanding mathematical content, liking math and getting good grades. The importance of getting good grades and liking mathematics is consistent with findings based on National Assessment of Educational Progress (NAEP) data for 1986, which was previously analyzed by M. L. Johnson (1989). In this analysis, M. L. Johnson (1989) found that good grades are perceived by students as important and that two-thirds of African American seventh-grade students like mathematics better than all other academic subjects. Similarly, five out of six mathematically successful African American college students in Powell-Mikle's (2001) study mentioned a love of the discipline when asked questions to elicit their feelings about mathematics and mathematics education. For these students, positive feelings about mathematics as a subject contributed to positive feelings regarding their mathematics education. This in turn, led to their mathematical success at the college level. Successful mathematics students have also been previously defined by D. Martin (2000) as those who receive high grades in their mathematics classes and those expressing positive attitudes

towards learning mathematics. This identification of mathematical success best supports two aspects of the current study participants' definition of mathematical success: getting good grades and liking mathematics as discipline.

A third aspect of the participants' definition of mathematical success was described as an ability to understand mathematical content and concepts. In some cases, the participants defined success in mathematics as being able to understand these concepts better than their peers. This definition of mathematical success as understanding mathematical content is consistent with recent standards for mathematics in kindergarten through 12th grade set forth by the National Council of Teachers of Mathematics (NCTM). Across all grade levels, these standards identify mathematical competency and student success with developing mathematical understanding throughout various mathematical topics and content areas (NCTM, 2000).

Definitions of mathematical success as perceived by a majority of the students in the current study did not include several aspects of the definition provided by other mathematically successful African American students in previous literature. For example, high-achieving African American college students in Powell-Mikle's (2001) study felt that they were mathematically successful not only because they had good grades in math, but because they could apply the mathematics that they had learned in their everyday lives. Similarly, although those participants would all take longer than the typical four years to graduate, Powell-Mikle (2001) identified these students as successful since they had endured through challenging difficulties and had eventually achieved their goals. Drawing from Powell-Mikle's (2001) perception of these

students as mathematically successful, alternative definitions of mathematical success may also include an ability to persist within the study of the discipline and a demonstrated ability to apply mathematical knowledge in everyday life. It should be noted here that Adrianna mentioned the application of mathematical concepts as part of her definition of mathematical success while Tina and James referred to mathematical success as an ability to persist and overcome challenges. Although these aspects of the definition were mentioned, a majority of the participants defined mathematical success as understanding mathematical concepts, getting good grades and liking mathematics as a discipline.

Mathematical Success Factors

According to Germain (1991), a sociocultural perspective examines humans interacting continuously with their physical and social environments. Drawing from this perspective, I chose to examine characteristics of the community college environment and various social and cultural environments (family, peers, etc.) that are perceived by the participants to encourage mathematical success. Within this framework, an attempt was made to analyze the identified mathematical success factors among these students as characteristics of various environments that support mathematical success among this population within a community college setting.

Working within the framework of these students' definition of mathematical success, I sought to identify and understand the various factors that the students perceived to directly impact or influence their mathematical success at the community college level. Interview data revealed that a majority of the students perceived the following factors to contribute to their mathematical success at the community

college level: liking mathematics, parental influences, perseverance despite challenges, individual effort and hard work, positive student-teacher interactions, the relevance of mathematics, cultural influences, strong mathematical backgrounds, mathematics identities, race, good teaching, and positive peer interactions. The following is a discussion of the findings as they appeared to emerge within three major themes as follows: disciplinary success factors, support systems as factors of success and personal success factors.

Success Factors Related to Mathematics as a Discipline

Evidence across all cases in the current study suggests that these students were successful mathematically as a result of several factors related to mathematics as a discipline. These factors included a strong mathematical foundation, an understanding of the relevance of mathematics as a discipline, a positive mathematics identity and liking mathematics as a discipline. This last factor became an underlying theme throughout the study as several participants perceived that mathematical success was somehow connected to their love of the discipline. I will begin here with an exploration of this relationship as it emerged through the findings.

Mathematical success and liking mathematics. In four out of the six cases, students defined mathematical success as getting good grades, understanding mathematical content and liking mathematics as a discipline. For those who identified mathematical success with liking mathematics, there appeared to be a relationship between liking mathematics and feeling mathematically successful. In these cases, liking mathematics led to mathematical success, mathematical success led to liking mathematics, or feeling mathematically successful and liking mathematics were

simultaneous events. In most cases however, students started to do well in mathematics and then began to like math as a result. These findings are consistent with previous work by Hart and Stanic (1989) suggesting that the relationship between mathematics achievement and attitudes are complimentary. In support of this relationship, positive attitudes towards mathematics have previously been shown to lead to greater mathematical understanding, while greater mathematical understanding has been shown to lead to more positive attitudes towards mathematics (Hart & Stanic, 1989). Likewise, mathematics self-efficacy defined by Hackett and Betz (1989) as one's attitude towards both mathematics as a discipline and his or her ability to succeed mathematically, has previously been shown to be an important predictor of one's future mathematics performance and achievement (Hackett, 1985; Hackett & Betz, 1989).

A connection between liking mathematics and mathematical success was experienced by Ray who began to like and appreciate mathematics as a result of developing a deeper understanding of the material. For Charity and Adelle, liking mathematics and becoming mathematically successful appeared to be simultaneous events. In the cases of James and Adrianna, liking mathematics at an early age led to mathematical success at the college level. This connection between liking mathematics and mathematical success can also be seen within D. Martin's (2000) conceptualization of success as evidenced by "students receiving high grades in mathematics and expressing positive attitudes about mathematics learning" (D. Martin, 2000, p. 124). While the intent of the current study was not to develop a grounded theory pertaining to mathematical success, the experiences of these students

illustrates many possible relationships between mathematical success and liking mathematics. Among these, this work suggests the possibility that liking mathematics leads to mathematical success, mathematical success leads to liking math, and/or feeling mathematically successful and liking mathematics are events which occur simultaneously. Future research should further examine the nature of these relationships among students studying mathematics.

The relevance of mathematics. Previous research involving high-achieving African American students in mathematics has found that socioeconomic and career goals illuminate the relevance of mathematics as a discipline, as mathematical knowledge is often required to meet these goals (D. Martin, 2000). In other words, students became aware that they must utilize mathematics and/or mathematical knowledge in order to achieve their goals. In this way, academic and mathematical success can be intimately connected to the achievement of personal goals. Throughout the current study, these connections emerged as students began to recognize the relationship between mathematical knowledge acquisition and their ability to meet their current and future career goals. In some cases, students described applying this mathematical knowledge in their other courses or on the job. Likewise, all participants identified clearly defined career goals which they perceived to be linked to developing mathematical knowledge. This made mathematical knowledge relevant. This is consistent with previous research indicating that mathematically successful African American students tend to have clearly defined career goals which are subsequently linked to their motivation to succeed academically and mathematically (D. Martin, 2000; Powell-Mikle, 2001; Thompson & Lewis, 2005).

Mathematically successful African American middle school students interviewed in D. Martin's (2000) work generally "had developed clear and focused short-term and long-term goals that they believed would not be possible without education" (D. Martin, 2000, p. 123). Similarly, an African American parent and community college student connected mathematical knowledge with a desire to achieve various economic goals. Like this parent, many of the students in the current study saw this type of connection and were therefore motivated to succeed in their current mathematics courses so that they could acquire additional mathematical knowledge. This is consistent with results of a case study conducted by Thompson & Lewis (2005). In that study, Thompson & Lewis (2005) found that a mathematically successful African American student was highly motivated to succeed in math as a result of his career choice to be an aircraft pilot. Thompson & Lewis (2005) proceeded to discuss how this career choice played a major role in his mathematical success at the high school level. Similarly, the careers chosen by the participants in the current study required mathematical knowledge. This seemingly motivated them to maintain success in their mathematics courses since mathematical knowledge was extremely relevant to their coursework and careers.

Within the discipline of mathematics and mathematics education, Tate (1994) argued that traditional mathematics curricula have failed to optimize student success in advanced mathematics courses by not promoting the relevance of mathematics to students' everyday lives. This is consistent with problems identified by parents of African American students in D. Martin's (2000) study. These parents suggested that African American students do not persist in

mathematics because they do not see its purpose or utility in their lives. Likewise, mathematically successful college students in Powell-Mikle's (2001) study "felt that they were successful because they could apply the reasoning and logic skills in mathematics to their everyday lives" (Powell-Mikle, 2001, pp. 14). For the participants in the current study, the relevance of mathematics to their lives was apparent as they perceived math to be something that they would utilize currently and in the future. In some cases they spoke of utilizing math in other courses or applying it on the job. How these students perceived math to be relevant to their lives was best illustrated by Tina's observation that math is "everything we do." These students' ability to understand the relevance of mathematical knowledge to their lives served as a motivational factor which enabled them to achieve and maintain success within discipline.

Each participant defined a future career goal where mathematical knowledge was relevant. From a sociocultural perspective, a student's ability to clearly define future and career goals motivating mathematical success can be highly contingent upon various social, cultural, and community factors. These factors might include parental involvement and interest, goals that are valued within the community, and shared cultural values. These factors interact to influence a student's determination of future goals and their motivation to achieve them. In this way, the nature of these goals and their relationship to mathematical knowledge acquisition can directly impact mathematical success among African American students. For the participants in the current study, mathematical success was achieved and maintained as a result of a variety of factors including the utility and relevance of mathematics in their

everyday lives and future careers. Among mathematically successful African American students, socioeconomic and career goals have previously been found to impact mathematics identities as they set the stage for mathematics to be meaningful and instrumental in achieving these goals (D. Martin, 2000).

A strong mathematical background. Across all cases, students brought to their collegiate study, a strong pre-college mathematical background which they perceived to greatly contribute to their ability to succeed mathematically. These students immersed themselves in the study of the discipline early on, bringing with them a deeper understanding of mathematical concepts from rigorous coursework at the elementary, middle and high school levels. These findings are consistent with previous literature which indicates that mathematically successful African American students tend to experience rigorous high school mathematics coursework and curricula (Gutierrez, 2000; Moody, 2004; Powell-Mikle, 2001; Thompson & Lewis, 2005). Likewise, African Americans (and Hispanics) who are underrepresented in advanced mathematics courses in high school, generally do not enroll in four-year institutions immediately after high school as frequently as White students (Perna, 2000). This finding suggests the need for a strong, pre-college background in mathematics coursework among minority students.

Although Adrianna was the only student to have participated in an identified talented and gifted program, all participants felt that they were exposed to a variety of advanced mathematics topics prior to college. Collectively, these students perceived that their preparation for collegiate mathematics was adequate. Since these students were considered to be high-performing in their mathematics courses at the

community college level, these findings suggest a relationship between mathematical success in college and a strong, pre-college math background. For this reason, it is important to consider student access to advanced mathematics courses prior to college.

The presence of preexisting social structures such as tracking has been found to limit opportunities for many African American students to access advanced mathematics courses prior to college (D. Martin, 2000; Silva, Moses, Rivers, & Johnson, 1990; Tate, 1995). As a result of tracking, a disproportionate number of African American students remain in lower-level mathematics classrooms, are provided less resources, and are given fewer opportunities to learn than those in more advanced mathematics classrooms (Oakes, 1990). Thus, fewer African American students are receiving the adequate preparation in high school that is necessary for subsequent success in college mathematics. These practices appear to be inconsistent with the recent NCTM standards' equity principle which argues that, "all students should have access to an excellent and equitable mathematics program that provides solid support for their learning and is responsive to their prior knowledge, intellectual strengths, and personal interests" (NCTM, 2000, p. 13). Despite these efforts, many of our minority and African American students are still unprepared when they enter institutions of higher learning. These unprepared students are entering our colleges and universities with significantly fewer hours of high school coursework in science and mathematics (Treisman, 1992). Limited access to challenging courses and high-quality teaching at the middle and high school levels can eventually impact these students' ability to succeed in more advanced mathematics courses in college. These

factors inadvertently contribute to low numbers of African American students studying mathematics successfully at the college level.

From a sociocultural perspective, it is the interaction of societal institutions such as tracking and racism that prohibits many students from receiving adequate resources and advanced instructional programs. As a result of these practices, fewer African American students may be reaching their mathematical potential. Since a strong mathematical background was perceived by the participants to be a factor attributable to their success, future research should examine existing tracking practices in an effort to provide access to a more equitable mathematics programs for these students.

Mathematics identities. D. Martin (2006) defines mathematics identity as individually developed beliefs and dispositions included in one's self-concept. These beliefs and dispositions are the basis of how these students perceive their ability to do mathematics. Similarly, Hackett and Betz (1989) define one's mathematics self-efficacy as one's attitude towards the discipline of mathematics and his or her ability to succeed mathematically. This assessment of one's mathematical ability differs "from other measures of attitudes towards mathematics in that mathematics self-efficacy is a situational or problem-specific assessment of an individual's confidence in her or his ability to successfully perform or accomplish a particular task or problem" (Hackett & Betz, 1989, p. 262). As mathematics self-efficacy is more problem or task specific, this definition suggests that one's level of mathematics self-efficacy can vary from problem to problem and situation to situation. This is consistent with the ever-changing nature of one's mathematics identity which D.

Martin (2006) describes as constantly changing from that of a competent mathematics performer to that of an incompetent mathematics performer. From a sociocultural perspective, as situations and contexts change, one's perception of their mathematical ability may also change as it is informed through social interactions with others within these contexts. This individualized perception of mathematical ability can also be informed by how others perceive the student as a "doer" of mathematics (D. Martin, 2006). As the participants described their mathematical experiences within social and cultural contexts, additional information was gathered regarding their mathematics identities and how they were informed within these contexts.

As evidenced from their accounts, several students in the current study consistently perceived themselves to be highly competent mathematics performers, demonstrating aspects of positive mathematics identities. This was even the case among those students who had to endure various challenges. For Adrianna, negative interactions with her math professors and low expectations could have easily led to a negative mathematics identity and low performance in her mathematics courses. Despite these negative experiences however, Adrianna maintained a strong mathematics identity. This positive identity was previously informed and encouraged by her fourth grade teacher. This teacher supported Adrianna, conveyed high expectations, and frequently conveyed the message that Adrianna could do mathematics. These positive experiences provided Adrianna with the confidence necessary to maintain a positive mathematics identity in spite of negative messages conveyed by college faculty. This result is similar to findings from Moody's (2001, 2004) phenomenological study examining mathematically successful African

American female students. In Moody's (2001, 2004) study, one female student attributed her mathematical success in college to the extra attention she received from her fifth grade mathematics teacher. This student was able to succeed despite negative racialized experiences with her math teachers. Contrastingly, these instances differ greatly from the experiences of other African Americans who have suffered long-term negative effects to their mathematics identities as a result of negative messages and low expectations conveyed by teachers. African American parents in D. Martin's (2000) study discussed how the low expectations of mostly White teachers had a negative effect on both their mathematics identity and their ability to succeed within the discipline. Fortunately, this was not the case for many of the participants in the current study who seemingly overcame these challenges and maintained a positive mathematics identity throughout their collegiate study.

Although most of the students continued to maintain a positive mathematics identity, several participants demonstrated aspects of a mathematics identity which was constantly changing. James' mathematics identity appears to be mostly positive but continues to evolve. At one time during the interview, James perceived his mathematical success to be based entirely on his superior mathematical abilities. He perceived these abilities to be independent from anything that his parents or teachers had done. This suggests James' identification with the competent mathematics performer as previously defined by D. Martin (2006). Later, James goes on to describe himself as only somewhat successful in math. This suggests that he may not view himself as such a competent performer after all. The evolving aspect of one's mathematics identity has previously been discussed by D. Martin (2006) who argues

that an individual may choose a mathematics identity which ranges between being a competent performer and an incompetent performer, “often flowing back and forth” (D. Martin, 2006, pp. 206). Drawing from Hackett and Betz’s (1989) definition of mathematics self-efficacy, a student may have a high level of mathematics self-efficacy; feeling confident that he or she can complete the immediate mathematics problem or task. This level of self-efficacy may change however, when he or she feels unable to accomplish another set task. Both terms, mathematics identity and self-efficacy, can be used to describe the participants’ attitudes towards the discipline of mathematics as well as their confidence in their ability to succeed mathematically. Seemingly, positive mathematics identities and/or higher levels of mathematics self-efficacy greatly contributed to these students’ ability to succeed mathematically at the community college level.

Although several students displayed aspects of mathematics identities which were evolving, all students demonstrated characteristics of a positive mathematics identity at times. In many cases, these identities appeared to be greatly informed by the students’ interactions with their teachers. This finding suggests the impact of positive student-teacher interactions on the mathematics identities of African American students and their subsequent mathematical success. According to D. Martin (2000), the messages that teachers convey to African American students about mathematics and their ability to do mathematics can contribute to a “mathematics socialization process that African American students undergo in school and classroom contexts.” (D. Martin, 2000, p. 14). This process can lead to the formation of positive and/or negative mathematics identities.

Throughout the current study, the theme concerning the impact of disciplinary factors on these students' mathematical success suggests that mathematical success at the college level cannot be examined solely within the context of overall academic success. On the contrary, mathematical success is largely affected by factors specific to the discipline and how one is immersed within the study of the discipline. Whether or not a student enjoys math for the sake of math, whether or not they consider mathematical knowledge as relevant, how they perceive their ability to do mathematics, and their mathematical preparation prior to college are all factors related to the mathematical success of the individual. From a sociocultural perspective, many of these factors are also influenced through social interactions with others such as teachers, peers, family, and community members. Positive interactions between students of mathematics and these various individuals can contribute to the formation of a support system that students can continue to access throughout their study. These support systems work to help students achieve and maintain mathematical success at the college level.

Support Systems as Factors of Success

A second theme throughout this study was the students' reliance on various support systems which greatly contributed to their ability to achieve and maintain success in mathematics. All participants received support through interactions with teachers, parents, peers and cultural groups. These students perceived these relationships and interactions to have a huge impact on their ability to succeed mathematically at the college level. As the students described these relationships and interactions, it became apparent that these individuals cared about the lives of these

students, their future, and their academic and mathematical success at the college level. This theme of caring was extremely evident when examining these students relationships with faculty and parents.

Teacher support. Support provided by math faculty at the community college seemingly had a major impact on these students' mathematics identities and subsequent mathematical success. This support came in many forms including conveyed high expectations of students and academic support provided through positive student-teacher interactions inside and outside of the classroom. These interactions consistently conveyed to students messages of caring and concern for their success.

Previous research has indicated that frequent student-faculty interactions are positively associated with academic performance and persistence at the college level (Pascarella & Terenzini, 1978; Terenzini & Pascarella, 1980). This idea is also consistent with previous work by Tinto (1998) who argued that the level of commitment that students have to their academic goals is influenced by their academic and social interactions within the institution. This often includes interactions with faculty and staff. Similarly, when examining Astin's (1984) research covering more than 20 years, Levin and Levin (1991) found that quality interactions with college faculty were the most important factor determining persistence among minority college students.

Among African American students attending community colleges, Green's (2003) findings suggest a relationship between a student's decision to persist at an institution and the existence of positive student-faculty relationships. Similarly,

among African American males attending community colleges in California, Bush (2004) found student-faculty interaction was a stronger predictor of persistence rates than various other variables including campus involvement, peer interaction and campus climate. Moreover, student-faculty interaction was also shown to be a predictor of transfer rates to four-year institutions and grade point averages (GPAs) for these men (Bush, 2004). These results are consistent with the findings of several studies documenting the benefits of positive student-teacher interactions among academically successful African American students in both high school and college environments (Fries-Britt, 1998; Gutierrez, 2000; Littleton 2001; Moody, 2004; Powell-Mikle, 2001). Considering these findings, it is not surprising that all participants in the current study (except for Adrianna) spoke of positive interactions with math faculty at their institution. A significant theme across the current cases was the impact of positive mathematical experiences with teachers in classrooms and office hours which greatly contributed their mathematical success. More specifically, many of the participants felt comfortable seeking academic help from professors and were encouraged by them. This is consistent with results discussed by Littleton (2001) who found that African American students attending Predominantly White Institutions (PWI's) perceived the positive influence of faculty to be the most important factor attributable to their ability to persist in college. Similarly, Powell-Mikle (2000) found that teacher availability and a willingness to adequately answer questions to be characteristics of caring and helpful teachers as perceived by mathematically successful, African American college students. This theme of caring teachers was also evidenced within the mathematical experiences of two successful,

African American female students in Moody's (2001, 2004) work. For these students, caring mathematics teachers encouraged them and were available and willing to help when content became difficult. This theme was best exemplified in the current study in the case of Ray. For Ray, Dr. Kendall played the roles of both teacher and mentor; providing both encouragement and academic support throughout his coursework. As a result of this unique experience, Ray identified his relationship with Dr. Kendall as a major factor attributable to his mathematical success. This is not surprising since faculty mentoring has previously been shown to be the sole predictor of persistence among African American students attending PWI's (Himelhoch, Nichols, Ball, & Black, 1997). Likewise, meaningful relationships between African American students and their teachers have also been found to positively impact participation in math and science classrooms at the high school level (Brand, Glasson, & Green, 2006).

Many of the positive interactions with math faculty described by the participants in the current study included instances where faculty conveyed high expectations to students. In response to these expectations, students rose to the occasion and were able to succeed. For example, all students except Adrianna provided examples of high expectations and disciplined classrooms which seemingly contributed to their success. This was not terribly surprising, since relaxed teaching styles and low expectations of teachers have previously been found to be a disservice to African American students in the mathematics classroom (Strutchens, 1993). For a sixth-grade African American student in Strutchens' (1993) study, a teacher's relaxed personality contributed to inconsistent student behavior and subsequently, lower grades. On the other hand, when the same teacher admitted to having higher

expectations of other students, those students rose to the occasion and met his expectations. Conveying high expectations of students studying mathematics is also consistent with the equity principle in the recent NCTM (2000) standards. This principle promotes the communication of high expectations from teachers to students “in their interactions with students during classroom instruction, through their comments on students’ papers, when assigning students to instructional groups, through the presence or absence of consistent support for students who are striving for high levels of attainment, and in their contacts with significant adults in a student’s life” (NCTM, 2000, p. 12). Similar to the participants in the current study, other African American college students have also discussed the importance of college faculty who were able to convey high expectations while providing tough love when needed (Littleton, 2001). These examples are all consistent with Ogbu’s (1985) cultural-ecological model suggesting that African American children’s academic competencies are adaptations of both environmental demands and adult expectations of their behavior.

Although many of the participants spoke highly of their interactions with math faculty, none of the positive interactions described by participants were with African American professors. For example, Dr. Kendall was East Indian and all other professors discussed were Caucasian. This is inconsistent with work by Irvine (1989) who argued that African American children are best taught by African American teachers who are more aware of their culture. Despite differences in culture or race, the participants in the current study seemed to benefit through positive relationships with math faculty. Previous research has documented African Americans’ desire to

have more African American faculty and administrators on their college campuses (Littleton, 2001). This lack of African American faculty in math and science has also been evidenced in similar studies. Fries-Britt (1998) found that high-achieving African American college students studying in these areas interacted mostly with faculty who were not African American or were outside of these fields. Although previous research indicates that African American students desire more interactions with African American faculty, the current study did not address whether or not this was perceived as a problem by the participants. The only case where the race of the faculty became an issue was with Adrianna, who perceived to have experienced racial discrimination. In Adrianna's case, there may have been a desire to have more African American faculty to alleviate this problem. According to the Maryland State Higher Education Commission (MHEC), African American faculty comprise only 16.9% and 5.9% of full-time faculty respectively at CC1 and CC2 (Maryland State Higher Education Commission, 2003). As a result, few opportunities would have been provided for the participants to interact with mathematics professors who were also African American. Future research should explore the relationship between the race of mathematics faculty and mathematical success among this population of students.

Parental guidance and support. As revealed during the interviews, parents were perceived by all the participants to have played a major role in their mathematical success at the community college level. Various instances of parental involvement included academic and financial support, encouragement, and high expectations. Throughout the interviews, parental support was shown to

be related to each student's mathematical success in a variety of ways. Among these, a major finding was support provided by parents who brought with them a considerable amount of social and cultural capital to their interactions with the students.

Aside from Tina and Ray who were first generation college students, all participants' parents had each received one or two Bachelor's degrees. Among this group, many had obtained Master's degrees or had completed graduate coursework. Charity's father had a Ph.D and Adelle's parents were both pursuing doctorates. For these college-educated parents, a certain amount of social and cultural capital was accessed and utilized to assist the students in reaching their mathematical potential. This capital helped contribute to providing and sustaining their children's educations prior to and throughout college.

For the purpose of this dissertation, social capital will refer to the social resources and networks that foster and support educational achievement or attainment and the ways in which these networks are maintained (Hemmings, 2007; Morrow, 1999). Likewise, cultural capital will be defined as a system of attributes which define one's class status as it is derived in part, from one's parents (Bourdieu, 1986; Bourdieu & Passeron, 1977). These attributes can assist students in navigating through academic environments and experiences. Utilizing these definitions, examples of the benefits of social and cultural capital were discovered across several cases. For example, Adelle describes how her father spent time tutoring her when she was having problems in math during the elementary years. In this way, a parents' level of education can be seen as one of several factors determining the kind of

academic support that can be provided for the student at home (Strutchens, 1993). Likewise, depending on a parent's level of education, parents may interact with their children within a mathematics context. This can determine how African American students will perform within the mathematics classroom (Strutchens, 1993). For Adelle, having her father tutor her in mathematics positively influenced her mathematical success. From a sociocultural perspective, the social and cultural capital that Adelle's parents brought to their interactions greatly contributed to her ability to succeed mathematically at the college level.

Positive influences based on parents' educational levels are also consistent with previous research indicating that parents with baccalaureate and graduate degrees more often place children in college preparatory courses as they tend to be more aware of how to maneuver the system of higher education (Oakes, 1990; Useem, 1990). Likewise, Oakes (1990) argued that students' mathematical performance in their classes is often associated with socioeconomic status (sometimes based on parents' educational levels) and parental involvement and expectations; setting them up to succeed in college. For example, Adelle's parents (doctoral students), were able to act quickly when she began having difficulty in mathematics by personally tutoring her and even providing her with a paid tutor. This eventually led to a better mathematical foundation prior to college and increased mathematical success at the college level.

Having achieved a high level of education themselves, many of these parents held high expectations for their children. This motivated these students to meet their expectations and achieve academic success. This is consistent with previous research

in higher education finding parent education to be a significant predictor of college GPAs, degree aspirations, and rates of persistence among African American males (Bush, 2004). These and similar findings suggest that college educated parents can have a greater influence on their children's educational choices, subsequently preparing them for academic success at the college level. This influence was found to be consistent among the four participants who had college educated parents.

Despite a variety of educational and socioeconomic backgrounds, consistent across all cases was evidence that one or both parents held high expectations and concern for their child's academic and mathematical performance. This care and concern helped contribute to their ability to succeed mathematically. This finding is consistent with results from Strutchens' (1993) study which found that parental income and educational levels were not differential factors in determining the mathematical performance of some African American students.

The participants in the current study were all well aware of their parents' high academic expectations. These expectations were consistently conveyed to students as a high value was placed on all academic endeavors, and students were encouraged to meet their academic goals. This finding is similar to M. L. Johnson's (1989) findings when examining the 1986 NAEP data. According to M. L. Johnson (1989), minority students perceived their parents to have high expectations for them mathematically. For the participants in the current study, high expectations and the involvement of parents suggested a value being placed on education. This is consistent with the positive impact of parental involvement on college enrollment among high school students (Perna & Titus, 2005).

A value placed on acquiring academic knowledge was passed along to the participants through consistent support and encouragement. These interactions with parents greatly contributed to these students' mathematical success. Relationships between parental encouragement and college persistence have previously been discussed by Nora and Cabrera (1996). Their hypothesized causal model of persistence posits parental encouragement as a factor exerting a positive influence on minority students' educational aspirations and their decision to persist in college. When testing this model on both minority and non-minority college students, Nora and Cabrera (1996) discovered that "parental encouragement and support was found to exert a positive effect on the integration of students to college, on their academic and intellectual development, and on their academic performance and commitments" (Nora & Cabrera, 1996, p. 140). Based on the results of this current study, guidance, encouragement, support, and varying amounts of social and cultural capital from parents were all perceived to have greatly contributed to their individual mathematical success at the community college level.

Cultural group affiliations. Although all students perceived various success factors within each theme to contribute in some way to their mathematical success, evidence existed across all cases that these students perceived culture to impact their mathematical success. This is a particularly significant finding since all participants held ties to Caribbean and African immigrant cultures.

Although these students were perceived by their professors to be Black or African American, there were several obvious differences between this student

population and American-born Blacks. According to Ostine (1998), “ ‘Black’ does not necessarily equal ‘African American’ anymore,” (Ostine, 1998). Although the students originally self-designated themselves as Black or African American, further data collection revealed a more expanded racial identity for some of the participants. This expanded identity included various characteristics specific to Caribbean or African immigrant cultures. These cultural influences differentially contributed to their mathematical experiences as Black immigrants participating in mathematics.

Disparities in academic achievement between immigrant cultures and American born Blacks have previously been discussed within the literature. According to Doodoo (1997), Caribbeans are generally higher achievers than American born Blacks or African Americans. A proposed reason is that Caribbean immigrants come from a more favorable racial climate as the racial majority in their country. In these countries, positive Black role models can be more plentiful. As a result of this environment, the experiences of the Caribbean or African immigrants in America differ from the experiences and legacies of racism, discrimination, and slavery that are experienced by most Black Americans (Doodoo, 1997). In an article discussing the assimilation of African immigrants in the United States, Doodoo (1997) further differentiates the experience of slavery on the continent of Africa. He argues that for African slaves, slavery represented an ownership of labor and not an ownership of the individual. In fact, offspring of slaves were generally released from servitude, slaves had more rights than African American slaves, and adverse economic effects were limited as slaves could marry into the slave-owners’ families while opportunities were provided for economic advancement (Ajayi, 1996; Curtin,

1964; 1974; Doodoo, 1997; Klein, 1993). Add to this the fact that Africans were slaves within environments where they were not physically distinguishable from their slave owners and communities were racially homogeneous, African immigrants may receive psychological benefits and acquire more achievement-oriented psyches than American-born Blacks (Doodoo, 1997). These notions are consistent with recent census data reporting Africans as the most highly educated immigrant population in the US (Butcher, 1994; Katende, 1995). Similar benefits may be the case for Caribbeans who also immigrate from countries where they are in the racial majority. This type of racial climate has been found to lead to higher achievement orientations relative to American-born Blacks (Glazer & Moynihan, 1963; G. Lewis, 1983). From a Caribbean immigrant perspective, Tina and Ray may have also experienced mathematical learning and participation without some of the negative beliefs and psychological affects associated with Blacks and mathematics. This may have contributed greatly to their ability to succeed and maintain success within the discipline.

Evidence of high achieving Black/Caribbean immigrants has also been found among various studies reporting higher educational attainments, achievements, and aspirations among Black immigrants when compared to Black Americans (Gibson, 1991; Rong & Brown, 2001). These disparities in achievement have been attributed to differing parenting styles, individual effort, community support and networking (Gibson, 1991; Rong & Brown, 2001). This is highly consistent with the results of the current study reporting that students' perceived their mathematical success to be highly influenced by parenting styles characteristic of Caribbean and Nigerian

cultures. Adelle and Charity held strong ties to their Nigerian culture as first and second generation immigrants respectively. In both cases, Adelle and Charity described their parents as strict when it came to issues related to their coursework and grades. Both students' fathers took time out of their busy schedules to tutor them in math. Adelle's parents even paid for a tutor to work with her in math when it became difficult. These students also identified their parents concern for their grades and their strict parenting styles as aspects of Nigerian culture. For Adelle and Charity, these cultural influences provided high expectations and academic support which they perceived to greatly contribute to their mathematical success at the community college level.

Similar to the success of the participants with ties to Nigerian culture, students with links to Caribbean cultures (Ray, Tina, James, and Adrianna) also demonstrated a strong desire to achieve and maintain academic and mathematical success at the college level. This desire may have been based on a shared system of cultural beliefs and values. These beliefs appeared to include a high value placed on education and a desire to acquire mathematical knowledge to give back to their families and communities. This desire to bring back to their families and communities appeared to be tied to a Caribbean cultural heritage. As a result of this commitment, these students seemed to deliberately place themselves in a position where they would be able to help other Caribbeans and Black Americans. For example, Ray expressed a desire to tutor other African American students and return to Jamaica to teach mathematics in his old high school. As a first generation college student, Tina wanted to learn mathematics so she could bring this knowledge back to her family and to her own

children in the future. Likewise, Adrianna wanted to use her mathematical knowledge to become an economist and work for a non-profit organization. In doing so, she hoped to help her family and community. In these ways, these participants wanted to support other students, their families and their entire community so that they could all succeed mathematically. These findings are consistent with disposition such as giving back and helping others which have previously been linked with Caribbean immigrants (Vickerman, 1999). Vickerman (1999) found that Caribbean immigrants tended to send money back to relatives in their home countries in an effort to maintain strong social, economic and political bonds. Maintaining these ties might also be linked to increased educational and economic attainment found among Caribbean immigrants who have done considerably well when compared to other ethnic groups in regards to employment, adjustment and community (Rong & Brown, 2001; Rong & Brown, 2002).

Caribbean immigrants, Tina and Ray were both previous members and president of a student organization at CC1 known as the Caribbean Student Association (CSA). The purpose of this organization was to provide social activities, academic, and career support for Caribbean students attending CC1. Although they did not clearly identify this group as a mathematics success factor, Tina and Ray's affiliation with this organization may have attributed positively to their ability to socially integrate into the culture of the community college. As a result, this group affiliation may have impacted their mathematical and overall academic success. This idea is consistent with results of research conducted by S. Martin (1996) who found that social and educational activities provided through a

peer group for African American students (such as an African American Student Union) have served as a social and academic support for students who were in the minority at a male, catholic high school. Similarly, previous literature in higher education has reported on the relationships between social involvement at an institution and academic success, degree completion, and decisions to persist (Pascarella, 1985; Tinto, 1987). Although this was not discussed by students explicitly, the CSA seemed to serve as a way to better connect Tina and Ray to a school community which they may have felt isolated from. Through membership and participation in this organization, these students may have been able to minimize feelings of isolation similar to those of “black achiever isolation” experienced by other high-achieving African American college students (Fries-Britt, 1998). In Fries-Britt’s (1998) study, these students desired to be more connected to the larger Black community at their institution. For the participants in the current study, the CSA also offered an environment where students could share their unique concerns freely among others within in their cultural group. For example, Tina described instances where students shared experiences of perceived racism with CSA group members. In these ways, participation in the CSA may have greatly contributed to these students’ ability to persist at a PWI. This is consistent with Green’s (2003) findings that various cultural factors such as shared knowledge, oral traditions, and the ability for students to share their thoughts freely, are important factors that some African American students consider when deciding to persist at their institution. For these reasons, future

research should examine the impact of such ethnic and cultural student groups on the academic success of minority students attending PWI's.

Regardless of their cultural group affiliations (Caribbean or Nigerian), all participants discussed aspects of their culture which seemed to support their efforts while appearing to have a positive influence on their ability to succeed and persist within the study of the discipline. Collectively, these students reported that education was valued and supported by both their cultural groups. These and other aspects of their culture such as a desire to give back, served as supporting factors which contributed to high performance in not only their mathematics classes, but all of their academic courses. This result is found to be in support of previous research suggesting "that children of Caribbean and African immigrants have done well in US schools" (Rong & Brown, 2002, p. 251).

The role and influence of culture in this study revealed a larger concern in regards to mathematical success and participation among African American students. The limited number of American-born Black students in this study suggests the possibility of only a few American-born Blacks who are indeed mathematically successful at the college level and an increasing number of Black immigrants who are achieving and maintaining academic success. This was somewhat disconcerting but not entirely surprising given the previously discussed literature and findings regarding immigrants. Recently, scholars have raised this issue in regards to academic success among African Americans and disparity of achievement when African Americans are compared to other racial and ethnic groups. According to an article by Roach (2005), Harvard professors at a Black alumni gathering have remarked "the children of

African and Caribbean immigrants and children of biracial couples comprised two-thirds of Harvard's Black undergraduate population. Of the university's 530 Black undergraduates during the 2003-2004 academic year, only about 180 could claim a completely Black American heritage" (Roach, 2005, p. 38). This is consistent with work by other scholars reported by Roach (2005) who found 41% of Black freshmen at 28 elite colleges and universities to be self-identified immigrants, second generation immigrants, or of mixed race. Future research is needed to explore the mathematical experiences of immigrants and American-born Blacks, and how these differing experiences and perspectives impact mathematical success and participation. These findings will help to further the agenda of those wishing to close the achievement gap between American-born Blacks and other ethnic/minority groups. This may also change the way in which achievement data is collected in mathematics and other disciplines in the future.

Peer support. For four of the participants, positive interactions with peers during peer group study, tutoring sessions and conversations outside of class were perceived to greatly contribute to their ability to succeed mathematically at the community college level. For participants who actively chose to tutor other students, interactions during tutoring sessions provided opportunities for students to review key concepts that could be applied to their current coursework. These peer tutoring sessions seemed to increase their background knowledge while adequately preparing them for higher-level mathematics courses. This finding is consistent with a sociocultural approach to learning mathematics which argues that students construct mathematical meanings and understandings as they

communicate mathematically with others (Cobb, 1994; Cobb & Yackel, 1995; Vygotsky, 1994).

Several participants relied heavily on the academic assistance and support provided by their peers, greatly contributing to their overall mathematical success. For example, Ray worked diligently with on an older student on weekends in preparation for a high school exit exam in Jamaica. Such positive interactions are consistent with accounts of other high-achieving African American students who study with older peers such as their siblings (D. Martin, 2000). Peer interaction was also provided encouragement and support for Adelle as she studied with a classmate while taking Calculus and often conferred with peers outside of class to discuss course content and grades. Consistent also with D. Martin's (2000) work, such positive interactions with both peers and older students can help African American students to support each other academically through mutual encouragement and friendly academic competition. Similarly, Brew (2002) found that students benefit from the different perspectives provided by their peers which can contribute to increased mathematical understanding.

Although there was evidence across all cases that students had participated in group or peer study at some point (including prior to college), most of the interactions discussed occurred within the math tutoring lab on campus. Accounts of these interactions and the identification of the math tutoring lab as a success factor suggests the perceived benefits of organized peer study and tutoring for the participants and the positive affect that it had on their mathematical performance and success. Through these interactions, students appeared to increase

mathematical understanding while properly setting the stage to acquire additional mathematical knowledge in their courses. This finding provides additional support to research indicating that peer tutoring is an effective method of intervention among teachers (Enright & Axelrod, 1995) and that peer study may be related to increased mathematical performance among African American college students (Bonsangue, 1992; Fullilove & Treisman, 1990; Treisman, 1985). In addition to providing academic support, peer study groups among African American college students have supported students socially (Ellington, 2006), minimizing feelings of isolation typically experienced by high-achieving African American college students (Fries-Britt, 1998).

Although these experiences were infrequent, several students discussed the benefits of peer study outside of the tutoring labs. In most cases where studying with peers was mentioned, students described working only with one student. This apparent lack of frequent group study practices is inconsistent with previous research suggesting the benefits of group study among African American students studying college-level mathematics (Bonsangue, 1992; Fullilove & Treisman, 1990). Here I propose several reasons why these students might not have chosen to study in groups on a regular basis. One reason might have been because there were few other African American students to study with on a predominantly White campus. When examining successful African American students at the college level, study groups in previous studies generally consisted of all African American or minority students (Bonsangue, 1992; Fries-Britt, 1998; Fullilove & Treisman, 1990). Secondly, it should be noted that the nature of a community college institution is not as conducive to group study

as most four-year institutions where this type of research is generally conducted. The lack of residential facilities available and the additional commitments of students outside of school do not allow many opportunities for students to spend a considerable amount of time on campus. This may make it extremely difficult for community college students to schedule regular study time with each other. Perhaps these factors resulted in fewer instances of group study and more individualized study time for the participants.

Aside from a few isolated instances (many of which occurred prior to college), these students did not appear to actively seek out opportunities to work with others. Participants often described working alone on a regular basis. Adelle and Ray were the only students who reported working with another student regularly outside of the tutoring lab at the college level. This is consistent with findings suggesting that “cooperative learning is not preferred by all African American children and that African American students may vary in their reasons for not wanting to learn in cooperative groups” (Strutchens, 1993, p. 124).

Although these students did not actively engage in peer group study regularly, many worked with their peers consistently within the mathematics tutoring lab. For the students who did work with others, the benefits were apparent. Collaboration among peers can promote a community of learners in which minimal emphasis is placed on the success of the individual student and the nature of individual student success is impacted by the mathematical success of the larger learning community. From a sociocultural perspective, these findings suggest that the individual success of the African American student is not entirely independent of the success of their

community. This suggests a connection between mathematical success and social interactions with others including peers, teachers, family members, cultural group members, and the community at large. In order to encourage and maintain mathematical success among this student population, classroom and community environments in community colleges should continue to be supportive of peer collaboration and positive student-teacher interactions. In this spirit, it is the responsibility of the African American community to ensure that these students are supported and offered continued encouragement by their families, schools, and communities.

Personal Success Factors

Although the participants in this study perceived disciplinary and sociocultural factors to be attributable to their success, a third theme emerged regarding mathematical success factors that were more personal in nature. These students also attributed their mathematical success to various personal success factors such as their ability to persevere and their individualized responses to racialized situations as African American or Black students participating in the study of mathematics.

Persevering despite challenges. According to Tinto's (1975) student departure theory, influences on student persistence in college include various institutional variables such as interaction with peers, faculty and participation in extracurricular activities. These variables can contribute to each student's ability to integrate effectively within their college environment and their subsequent ability to persist at the institution. Findings of the current study revealed these and various other factors

that were perceived by the students to be directly attributable to their mathematical success and ability to persevere despite various challenges along the way.

As this study sought to examine mathematical success among community college students, examining success factors as they related to persistence seemed inappropriate for students who were not close to graduating from their institution. All participants were first, second, or third-year college students except for Adriana who had already received her Bachelor's degree. Since persistence in higher education generally refers to degree attainment (United States Department of Education, 2007), I instead chose to examine each student's ability to successfully continue throughout the study of the discipline as they overcame various challenges along the way. These students overcame academic, racial and financial challenges while maintaining grades of A's or B's their college math courses. For the purpose of this dissertation, I will refer to this ability to overcome these challenges while maintaining high grades in their courses as perseverance. Evidence of perseverance was found across all cases.

During their course of study, each participant encountered academic and/or financial challenges which they were able to overcome successfully. Tina's struggles included financing her own education and passing Pre-calculus. For Adrianna, proving to her doubting professors that she could be a successful math student was a struggle. For these and other African American college students, a variety of interpersonal, community and cultural factors can impact their ability to overcome such challenges. In these cases, an encouraging teacher or parent sometimes helped contribute to their ability to persevere.

How one's community and culture interacts to support or thwart one's ability to achieve academically or mathematically can directly affect that student's ability to achieve and maintain academic success. For the participants in this study, family influences, cultural influences and positive student-teacher interactions were among the factors impacting these students' ability to persevere and succeed mathematically. Among family and cultural influences were a strong work ethic and a high value placed on education. These cultural and family beliefs helped to create a strong desire amongst these students to persevere within the study of the discipline. Such relationships between family influences and persistence in higher education have previously been found in various studies examining African American college students (Ellington, 2006; T. L. Johnson, 2001; Littleton, 2001). Among African American students persisting towards graduation, Littleton (2001) found the third persistence factor to be family influences. Based on these results, Littleton (2001) argued for future research to further examine the relationship between student persistence and the influences of family. Likewise, academic persistence has been found to be related to family support among African American women attending community college (T. L. Johnson, 2001). While examining the success strategies of ten women who chose to persist, T. L. Johnson (2001) found family support to be a survival strategy reported by all students. In addition, pressure to meet financial obligations was also identified as a supporting factor attributing to their persistence. The obligation of having to finance their own education or work to stay in school motivated these women to persevere in college so that they could improve their financial situations. This sense of obligation was echoed in the current study through

the experiences of Charity, Tina, and Ray who were responsible for paying their own tuition. For example, Charity was motivated to do well academically so that she would not waste money. For these students, financial challenges served as motivational factors which led to demonstrated perseverance and academic success.

African American students' academic success in community colleges has previously been related to the quality of student-faculty relationships (Green, 2003; Bush, 2004). Green (2003) found a significant relationship between African American students' perceptions of their ability to achieve their academic goals and positive student-faculty relationships. Likewise, Bush (2004) discovered a strong relationship between student-faculty interactions and academic success among African American males. Collectively, these findings among African American community college students are both consistent and inconsistent with the results of the current study as it relates to the participants' ability to overcome academic challenges. Both Tina and James reported asking questions in class and consulting their mathematics professors when content became difficult. Such positive interactions with math faculty contributed to each student's ability to overcome their academic challenges. This allowed them to maintain their success within the discipline. Contrastingly, Adrianna spoke of mostly negative racialized experiences with math faculty at CC2. These experiences however, did not result in lower achievement. Instead, Adrianna chose to persevere despite these challenges. This was inconsistent with the results in Bush's (2004) study reporting lowered academic achievement among African American males experiencing negative interactions with faculty. Similarly, Nora and Cabrera (1996) found cognitive and affective

development among minority college students to be negatively influenced by perceptions of discrimination. Unlike these students, negative interactions with math faculty motivated Adrianna to prove them wrong and succeed academically. In this way, Adrianna was able to overcome perceived racial challenges and persevere.

When faced with academic, financial, and racial challenges, all students demonstrated an ability to overcome these challenges and persevere in the study of the discipline. This is consistent with Powell-Mikle's (2001) study which found mathematically successful African American students to persist within the study of the discipline despite difficulties. This ability to persist despite challenges indicated a high level of perseverance. For the participants in the current study, these abilities seemingly contributed to their mathematical success as evidenced through high grades achieved and maintained throughout their mathematics coursework. These and similar findings suggest a relationship between these students' ability to persevere despite challenges and mathematical success at the community college level.

The role of race. Previously, race has been viewed as a construct which is socially constructed (Rong & Brown, 2002). This is consistent with a sociocultural perspective suggesting that racialized experiences and racial identities can be informed through social interactions with others. These perspectives were drawn upon to examine the role of race and how it pertains to these students' participation and success in mathematics at the community college level.

As several of the participants in this study were first or second generation immigrants, examining the impact of race as it relates to each student's mathematical success was highly complex. Immigrant students brought with them a range of beliefs

and racialized experiences from their home countries as well as differing experiences living as immigrants within the US. To accommodate a variety of racial beliefs and experiences among the students, considerable care was taken when attempting to examine these students' perceived racialized experiences and their impact (or lack thereof) on their mathematical success.

For the majority of the participants, a positive association with race within the context of mathematical participation was evidenced. This was even the case despite perceived racism or previously held negative racial beliefs or experiences. For these students, this ability to maintain a positive association with race was seemingly related to earlier experiences with successful African Americans and/or ties to other countries where race is not strongly associated with negative beliefs. For example, James attended several pre-college institutions with large numbers of mathematically successful African American students. This allowed him to feel that race was not something that could negatively impact his ability to succeed. These findings are not surprising since successful African American students are likely to perceive themselves positively regarding their racial identity and status within their immediate cultural and community environment (Ogbu, 1986). Likewise, previous research has consistently identified positive cultural or racial experiences, beliefs and/or identities with academically and mathematically successful African American students (Boykin, 1986; Fordham, 1988; Fries-Britt, 1998; Moody, 2004; Prager, 1982).

Although a positive association between race and participation in mathematics remained consistent among most participants, preexisting beliefs more indicative of a negative association were also reported. These results required a closer look at

students' responses to racialized experiences. This idea is consistent with previous work by D. Martin (2006) who called for the avoidance of focusing on race as a central category of analysis and instead charged researchers to analyze the consequences of the construct race as it plays out in certain situations such as racism, racialized experiences and racialized inequality. The negative racial beliefs held by several of the current participants tended to associate African Americans with those who were generally not good at mathematics. Tina, Ray and Adrianna were well aware of negative beliefs and low expectations of others about African Americans and the perception that African Americans are generally not mathematically successful. These beliefs are shared by many African American students who continue to feel that mathematics is primarily a discipline for White males (M. L. Johnson, 1984) and/or that the discipline of mathematics represents an exclusive Western subculture that discourages their participation (Brand et al., 2006). This is partially explained in previous work by Ogbu (1986) who argued that African Americans are caste like minorities whose ancestors came to this country involuntarily through forced slavery. For this reason, many African Americans remain subordinate as a result of existing structural and societal systems. These systems continue to perpetuate their subordination through various institutions such as modern slavery. He proposed that such practices make it difficult for African Americans to view themselves as capable Americans in a variety of settings including educational and academic environments.

Previous research has continued to document the impact of negative racial experiences on the educational attainment of African American students. In some

cases, these experiences have been known to negatively affect a student's perception of their own racial identity (D. Martin, 2000). In other cases, African American students have been known to use these negative experiences as motivational factors, helping them to achieve greater academic success. This seemed to be the case for Adrianna who perceived acts of racism and discrimination on the part of mathematics faculty at CC2. These perceived acts of racism included instances where White teachers seemingly conveyed low expectations of her math performance and higher expectations for White students. Similar to Adrianna's experiences, low expectations of college math faculty have previously been documented among high-achieving African American female students at the college level (Moody, 2001, 2004). In response to these experiences, Adrianna was highly motivated to achieve and maintain mathematical success despite perceived low expectations of her abilities. She deliberately chose to prove her professors wrong. This response was similar to an African American female student in Moody's (2001, 2004) study. Having experienced negative racial incidents with a White mathematics teacher, this graduate student responded positively by increasing her effort and determination to succeed. The fact that the teacher readily demonstrated a lack of confidence in the graduate student's abilities prompted this determination (Moody, 2004). Similarly, other high-achieving African American college students have been shown to describe negative racialized experiences as motivational (Fries-Britt, 1998). Students in Fries-Britt's (1998) study expressed a need to excel academically because of their racial affiliation and role model status within their racial group. Similarly, high-achieving math majors in Ellington's (2006) study "felt a social responsibility to 'represent' their race or the

African-American community and serve as role models for other African-American students” (Ellington, 2006, p. 80). In these cases, purposeful academic success appeared to be these students’ response to poor treatment and low expectations based on racial group affiliations. In response to negative experiences, these students utilized individual agency to “engage in a kind of self-definition by opposition and resistance to what they considered to be negative influences” (D. Martin, 2000, p. 28).

The responsibility of being a role model for other African Americans was also a major theme which emerged as students discussed issues of race. Ray, Tina and Adrianna all felt a sense of responsibility to represent positively for their race. Like many of the mathematically successful African American middle school students in D. Martin’s (2000) work, these students felt a need to represent their race in a positive light by engaging in purposeful mathematical success and/or helping other African Americans to succeed mathematically. Even as a “brown” person, it was evident that Tina felt some sense of community among African Americans as she tried to excel academically as a representative of their group. Likewise, Adrianna felt pressure to always answer questions correctly in her math classes as a representative of “all Black knowledge.” In such cases, negative associations, beliefs or experiences as members of the African American community brought about purposeful mathematical success. This purpose seemed to create a sense of community as students chose to succeed for the race. Like the African American parents and students discussed in D. Martin’s (2000, 2006) work, purposeful mathematical success allowed the participants to resist subjugation as a result of discriminatory experiences or negative beliefs about African Americans. Collectively, these students

employed resistance to racialized beliefs and perceived racial inequality by choosing to utilize agency.

In some instances, African American students have been shown to respond both positively and negatively to racialized experiences within a mathematical context (D. Martin, 2000). Negative racial stereotypes or beliefs can sometimes have a negative impact on African American students' participation in mathematics (Brand et al., 2006) and can lead to a diminished value being placed on mathematical knowledge (D. Martin, 2000). For others, negative experiences increase motivation to study mathematics while placing increased value on acquiring mathematical knowledge (D. Martin, 2000). In the case of the participants in the current study, negative experiences and beliefs invoked a sense of agency on their behalf. Ray stated that he had "no choice" but to be mathematically successful as an African American. A similar response was reported by Ellington (2006) who found that high-achieving African American math majors chose to persist in their math programs in part, because of a strong desire to disprove negative stereotypes. Ray was well aware of the fact that he was perceived by others to look different (like an African American) and therefore must perform academically and mathematically in response to negative racial stereotypes. This perception suggests that racialized experiences in the context of mathematical participation may have invoked a positive response of mathematical success among these students. Similar to African American students and parents in previous literature (D. Martin, 2000, 2006; Moody, 2004), negative racial experiences and/or racial identities have previously been shown to invoke a sense of agency on

benefit of the individual. This can lead to increased mathematical success and the acquisition of additional math knowledge.

A connection between racialized experiences and mathematical success emerged as students began to discuss the racial composition of their mathematics classrooms. Even though Tina did not readily identify herself as African American on the preliminary questionnaire, she was anxious to point out that she was the only African American female in a Calculus 2 class among mostly White males. It was within this context that she described wanting to do well in the class as an African American female. In her perception, she was representing for both her race and her gender.

Although Tina does not appear to be preoccupied with race, she clearly noticed the under-representation of people of color in certain math and science classes. This was disappointing to her and perhaps attributed in some way to her sense of self. Tina's feelings are mirrored by an African American graduate student who expressed both anger and joy at being the only African American enrolled in an advanced mathematics course (Moody, 2001, 2004). The student expressed pride in herself as well as concern for her race as she observed very few African American students studying mathematics at this level. Likewise, other high-achieving African American math majors reported having to "adjust" to racial disparities between regular and honors classes, even at the high school level (Ellington, 2006). The small number of African American students in these classes conveys a message that math and science are not disciplines for people of color. This message is echoed as Ray states a need to perform well in mathematics since "African American is not popular

in mathematics.” In response, Ray feels the need to take on the responsibility of not only succeeding mathematically as a representative of the race, but also acquiring additional mathematical knowledge to share with other African Americans. In both cases, the response to being one of few African Americans studying mathematics was to positively represent for the race, succeed within the discipline and acquire additional mathematical knowledge to bring back to their families and communities. These responses support a connection between racialized experiences and mathematical success among these students. This connection can lead to success or a lack of success among African American students participating in mathematics.

In all cases, evidence was provided in support of positive responses to negative racialized experiences, leading to subsequent mathematical success. Similar responses among mathematically successful African American students and parents, have been found within the literature (D. Martin, 2000, 2006; Moody, 2004). Although this was the case for the participants in the current study, negative results of tracking and stereotypic beliefs have also been shown to lead to fewer African Americans persisting in mathematics related careers and even fewer serving as role models for other African American students. As a result, these factors have been shown to contribute to negative racial identities and low mathematical success among African American students (D. Martin, 2000; Moody, 2001). For the participants in the current study however, racialized experiences and beliefs invoked a positive response of mathematical participation and success. These results suggest a connection between racialized experiences and the mathematical participation of African American students.

Academic success in mathematics has previously been shown to be strongly linked to the mathematical and racial identities of students (D. Martin, 2000; Moody, 2004). Drawing from a sociocultural perspective, I propose here that these identities can also be influenced by one's cultural and community orientations. As factors contributing to mathematical success, these identities can be seen as malleable, interconnected, and influenced by situational contexts. According to D. Martin (2000), one's mathematics identity strongly parallels one's racial identity. I argue that in most cases, mathematics identities are connected to each student's sense of self in regards to racial group affiliation. Within a sociocultural context, both are informed in part, through social interactions with others. This may include racialized experiences. Such interactions can be with teachers, peers, parents, siblings, community members, mentors, extended family members, etc. In addition to preexisting personal beliefs, these social interactions can directly impact the mathematical success of the African American student.

Conclusions

The current study's findings revealed various success factors that participants perceived as factors contributing to their mathematical success at the community college level. As interview data was analyzed, these findings appeared to emerge through three themes: factors related to mathematics as a discipline, support systems as factors, and more personal success factors related to the individual. Interview data suggests that all students drew from one or more factors within each theme. In other words, evidence suggested a presence of one or more success factors within each theme across all cases. In the case of disciplinary factors and support systems,

interview data from each student revealed the presence of all factors within each theme. Following this rationale, the strongest themes appeared to be disciplinary factors and support systems since all factors within these themes were present within each case. Personal success factors such as perseverance and the role of race were not evidenced across all cases, although they were prevalent among at least four cases.

As students appeared to describe success factors within each of these three categories (disciplinary factors, support systems, and personal success factors), findings suggest that these factors work together as well as independently to support the mathematical success of these students. For example, results suggest that all participants had an overall positive mathematics identity which contributed to their success. As each student's mathematics identity may have been informed through supportive interactions with parents or teachers, a relationship between these success factors can exist. Further, from a socio-cultural perspective, social interactions with parents, teachers and peers provide contexts or environments where mathematical learning occurs and positive mathematics identities are formed. As one's mathematics identity has previously been defined by D. Martin (2000; 2006) as one's attitude towards mathematics and one's beliefs regarding individual mathematics performance and abilities, mathematics identities can also be related to an individual's feelings regarding mathematics as a discipline. Results of the current study suggest an existing relationship between liking mathematics and mathematical success among the participants. A socio-cultural perspective supports connections between social interactions with others as contexts for positive mathematics identities to evolve, mathematical learning to occur and students to begin to like mathematics as a

discipline. Further research is necessary to determine the nature and degree of possible relationships between these factors and how they might work together, contributing to increased mathematical success among this student population.

Limitations

As this study sought to examine mathematical success and mathematical success factors among six Black/African American college students, assertions made are stated with caution and are specific to the cases presented. In addition, as an African American female who was also successful in the study of mathematics, the possibility of researcher bias exists. The following is a detailed discussion of such possible limitations to the study's findings and the efforts that were made to minimize them.

Acknowledging the fact that each participant in this study is an individual, each student brought to the study a variety of perceptions regarding themselves as African American/Black students participating in the study of mathematics. In addition, students brought perceptions regarding themselves as African American or Black persons living within the US. In some cases, these perspectives included those of immigrants and/or descendants of immigrants. For these reasons, the fore-mentioned success factors are only to be associated with these particular cases. Although it is extremely possible that these success factors will provide direction for increasing mathematical success among African Americans in general, the perceptions of these six students do not represent those of all African American or Black college students and should not be taken as such.

As four of the six participants were female, it seemed natural that issues of gender would emerge as students began to consider their mathematical experiences at the college level. In fact, it seemed highly possible that gender would be a major issue as many of these women were in the minority among males in their upper level mathematics classes. As the study progressed however, it became apparent that issues of gender were not as salient as the construct of race across all cases. Tina was the only participant to mention issues of gender as she discussed how it felt to be the only African American female in a Calculus class of mostly White males. As such, I chose not to delve far into this area. My decision to look no further into issues of gender as it relates to these students in no way implies that issues of gender are not factors to consider when examining the college experiences of African American students. On the contrary, I believe that African American students experience academic situations as African American females and African American males, and that these experiences may differ tremendously based on gender. This idea is in agreement with those who challenge lines of inquiry focusing solely on race or gender (Jackson, 1996). Although I admit to the significance of this factor, I felt that considerations of gender were beyond the scope of this dissertation. I do propose however, future research which seeks to examine similarities and differences among the mathematical experiences of African American male and African American female students attending college. Examining gender issues within the context of higher education is becoming more necessary as the number of African American females attending and successfully graduating from institutions of higher learning

continues to exceed the number of African American male graduates (MHEC, 2003; Ross & Jackson, 1991). Future research with this focus will allow for a more holistic approach to addressing the needs of African American students participating in mathematics.

CHAPTER 6: IMPLICATIONS

The richness of the data collected in this study revealed various findings with implications for community colleges and other institutions as they pertain to encouraging and sustaining the mathematical success of this population of students. The following is a discussion of these implications including recommendations for policy which may increase African American participation and success in mathematics at the college level and beyond. This discussion will also include proposed directions for future research.

Programs Promoting Academic Success among African Americans

According to a recent Minority Achievement Report examining institutions of higher education in the state of Maryland, Community College One (CC1) and Community College Two (CC2) have developed several programs for the purpose of increasing rates of graduation and transfer for at-risk students; including minorities and African Americans (Filipp, 2002). For example, in an effort to support minority and at-risk students attending CC1, a variety of programs have been implemented. The Summer Bridge Program allows minority high school students opportunities to learn about the college while participating in both academic and social campus activities. Students also participate in workshops which explore careers, develop study skills, and provide training in conflict resolution. Similarly, the Student Achievement and Success Program (SASP) targets first generation, low income or disabled college students. Its purpose is to integrate a variety of available academic support services in an effort to achieve the maximum level of success for these

students. Included in this program is a faculty/staff mentoring component shown to benefit most participants (Filipp, 2002). Likewise, CC2's Silas Craft Collegians Program targets African Americans and at-risk students to provide access to a variety of services including tutoring, mentoring, internships, assessment, advising, on-campus transfer programs and cultural enrichment activities. Since the program's inception in 2000, short-term retention rates have shown the program to be successful (Filipp, 2002). Although both institutions appear to be making a serious effort to support academic success among African American and minority students, it should be noted here that none of the participants had actually participated in any of these programs at their institution. Although they would seem to have been primary candidates, these students became successful without the assistance of these programs. This finding suggests that although such programs have good intent and are demonstrating progress on some level, these programs may not be targeting enough students that could truly benefit from their support. These results might also suggest that these programs are not effective enough and do not result in large numbers of African American or minority students succeeding in mathematics. Recruiting practices and budget allowances for these programs should be examined more closely in an effort to address the needs of more students of color. As community colleges continue to serve a large number of minority and first-generation college students, institutional programs should be created and supported which continue to provide more of these students with much needed academic, financial and emotional support. Such programs should also make an effort to diversify faculty and staff, providing unique opportunities for students to develop significant relationships

with faculty role models while increasing opportunities for mathematical and academic success. This recommendation is based on the current study's finding that teacher support was perceived by all participants to be a major factor contributing to their mathematical success at the community college level. From a socio-cultural perspective, positive interactions with faculty are activities which facilitate the learning of mathematics. In other words, learning occurs as students interact with math faculty in the classroom and during office hours. From an emergentist perspective, these interactions can provide conditions for students to individually construct mathematical knowledge. As we work to increase instances of mathematical success among all students, it is extremely important that we employ diverse faculty and staff at our colleges. A diverse faculty will provide a variety of role models that students can perceive as approachable. This may increase the likelihood of social interaction with faculty, making the difference as students pursue higher level mathematics.

Although both colleges in the study boast a broad dissemination of job announcements targeting minorities, CC1 offers specific programs for the purpose of creating a more diverse faculty and staff. Current practices include visiting target locations such as historically Black colleges and universities, and heavily marketing to African Americans (Filipp, 2002). Similarly, search committees at CC2 are trained regularly on hiring laws and how to make nonbiased decisions when hiring new staff and faculty. In addition, CC2 has an active diversity committee member on each search committee as part of an institutional diversity program (Filipp, 2002). These efforts are a first step to addressing the specific needs of African American students

who tend to recognize a lack of African American faculty and benefit whenever opportunities for mentoring and connection with African American faculty are possible (Littleton, 2001). Despite these efforts however, the number of minority faculty at CC1 has remained relatively constant over a number of years (Filipp, 2002). Future research should examine more closely the hiring practices of predominantly White institutions and the efforts that are currently in place to diversify the faculty and staff. These institutions should frequently review their current recruitment and hiring practices, and put forth additional effort to recruit minority faculty whenever current practices do not provide significant results. African American mathematics faculty for example, can serve as mentors and role models for African American students who can begin to perceive mathematics as a discipline for all people and not just White males (M. L. Johnson, 1984). From a socioicultural perspective, positive interactions with faculty can also lead to the formation of more positive racial and mathematics identities. Collectively, efforts to create a more diverse faculty and staff may set the stage for increased mathematical success among African American students.

School and Classroom Communities

As the current study's findings indicate that these mathematically successful students tend to have positive mathematics identities, classroom learning communities (as well as the larger school, family and community environments) must provide adequate support for African American students to maintain positive identities as learners of mathematics and positive racial identities as African Americans. This is even more important in schools where African American students

are in the minority. From a sociocultural perspective, these identities can be informed through social interactions within the school community. For this reason, predominantly White institutions (PWI's) should support African American students both socially and academically as they attempt to maintain their affiliation with their African American culture. In this effort, teachers and administrators must find ways to convey that positive academic practices can be characteristic of all cultures, not just those acceptable within the dominant culture.

As participants perceived positive interaction with peers to contribute to mathematical success, student organizations such as the Caribbean Student Association (CSA), may provide these students with academic and social support necessary to succeed. From an emergentist perspective, peer interactions such as peer group study within cultural student organizations may provide opportunities for knowledge to be individually constructed through social and cultural interactions (Cobb & Yackel, 1995). Students must also be provided with positive, African American role models (such as older students, community members or faculty) who model academic success and consistently encourage African American students to gain mathematical knowledge. These role models may come in the form of faculty or club advisors. Such positive interactions with other successful African Americans that support and validate academic success can also help these students formulate more positive racial and mathematics identities.

Implications for Mathematics Instruction

Although curricula and content are important, community colleges should also consider the quality of mathematics instruction provided and the skills of the

mathematics faculty interacting with these students. As five out of six participants discussed the significance of mathematics teaching, interactions with mathematics professors and the messages conveyed by the math faculty at their institution, it is imperative that community colleges continue to closely monitor the teaching practices of community college faculty. This may include frequent classroom observations, evaluation of teaching practices and additional consideration being given to student opinions provided through student evaluation. From a sociocultural perspective, learning is underlied by social processes (Vygotsky, 1981). These processes include student-teacher interactions. As a result, professional development for teachers should include conveying positive messages and high expectations to all students including African Americans. The equity principle in the recent National Council of Teachers or Mathematics (NCTM) standards document argues for the communication of high expectations from teachers to students (NCTM, 2000). In the case of the African American student, the messages conveyed by teachers can support or suspend mathematical progress and subsequent success. For these students, extreme care should be taken to assess what messages are being conveyed to students and to ensure that such messages are positive.

As the results of the current study suggest a relationship between mathematical success and liking mathematics, mathematics teachers of all grades should seek to encourage a genuine love of mathematics among their students as early as possible. To address a lack of participation in math and science among minority students, Chang (2002) challenged educators to strengthen the educational pipeline

prior to college in these areas. As evidenced by many of the participants in this study, it is prior to college that students tend to develop an interest in mathematics initially. The results of the current study suggest that if more students develop an early interest in mathematics, subsequent mathematical participation and success can follow. This early interest in mathematics can be developed through positive social interactions with mathematics teachers in pre-college classrooms. From an emergentist perspective, such social interactions can provide opportunities for students to both individually construct and concurrently develop mathematical knowledge (Cobb & Yackel, 1995). Since the current study's findings suggest that mathematical success may lead to liking mathematics as a discipline, developing this knowledge early on is extremely important. Among African American students, positive interactions with teachers may provide optimal conditions for knowledge construction in mathematics and fostering a love of the discipline. This may lead to more African Americans pursuing mathematics-related careers.

Developing this interest is difficult as few African Americans are exposed to advanced mathematics classes prior to college as a result of tracking (D. Martin, 2000; Oakes, 1990; Silva et al., 1990; Tate, 1995). In addition to examining and evaluating current tracking practices, I propose increasing the number and focus of academic programs which encourage and foster an interest in mathematics among younger students. More specifically, a special effort should be made to engage minority and African American students at the elementary, middle, and high school levels. Additional opportunities should also be provided to allow these students exposure to advanced mathematics classes, high-quality teaching and additional

educational resources. School counselors, administrators and teachers should work collaboratively to encourage these students to take advanced mathematics courses and persist within the study of the discipline. Throughout the entire pipeline (kindergarten through college), these individuals interact with students to promote the relevance and utility of mathematics while exposing them to math-related careers. These practices should help to encourage an interest in mathematics early on and increase mathematical participation and performance among this population of students.

Since many of the participants perceived mathematical success to be attributable to the relevance of mathematics as a discipline, instructional programs should be created in the earlier grades which demonstrate and promote the relevance and utility of mathematics. These programs can target African American students and other at-risk groups. In addition to such academic programs, I propose that family, community and academic institutions work collaboratively to provide opportunities for African American students to discover the utility of mathematics in their everyday lives. From a socioicultural perspective, social interactions within these communities can provide learning opportunities through social and cultural activities (Cobb & Yackel, 1995). Through these types of activities, students can develop additional knowledge in mathematics while clearly defining future and career goals where the relevance of mathematics may be apparent. Aspects of successful programs may include career workshops, field trips and job talks which emphasize the utility of mathematical knowledge and understanding. Family and community members can take an active role by conducting these career workshops and job talks within the classroom setting. To assist in these efforts, additional lines of inquiry should further

examine the connection between African American students' perceptions of the relevance and utility of mathematics, and subsequent mathematical success at all levels.

As this work suggests a relationship between hard work, perseverance, and mathematical success, community colleges should continue to provide classroom learning environments that support student learning by valuing education, individual effort and hard work. These types of learning communities can encourage individual students to give their best, increasing the likelihood of academic and mathematical success for all students. Likewise, creating a classroom culture that promotes high expectations and encourages effort can provide the necessary academic, cultural, and community support that these students need. Examples of such community support within the classroom may also include opportunities for students to engage in group study. As previously discussed by Treisman (1992), African American students can benefit mathematically from organized peer study groups. Drawing from an emergentist perspective, these groups can also provide environments and opportunities for students to construct knowledge individually as well as concurrently with their peers through social and cultural interactions (Cobb & Yackel, 1995). This type of academic support can maximize the potential for consistent effort, hard work, and subsequent mathematical success for this student population.

The proposed connection between racialized experiences, mathematics identities and mathematical success suggests a need to help African American students develop positive beliefs about the participation of African Americans in the study of mathematics. It is imperative that teachers of African American students

provide supportive learning environments that convey attitudes of eminent accomplishment and success for all students, especially African Americans. This is even more important in the advanced mathematics courses where African Americans tend to find themselves as one of few African Americans in classrooms that are predominantly White. According to Moody (2001), “there is a great need to question schooling practices that cause African American students to feel ‘badly’ about being the only African American in advanced mathematics courses” (Moody, 2001, p. 272). In an effort to address this problem, I call for educators to review current mathematics curricula, with the issues of these students in mind. For example, reform mathematics curricula at the undergraduate level should include various opportunities for students to explore mathematical formulas or theories which were previously proved or derived by African Americans. Some time should also be devoted to discussing the history of the people as well as the mathematics involved. Mathematics curricula which does not emphasize the contributions of diverse peoples and cultures may be the cause of a lack of academic and social integration experienced by many African Americans attending PWI’s. This lack of integration is a major factor attributing to these students’ lack of persistence/retention in higher education (Tinto, 1987). For African Americans, “culturally limited pedagogy often contributes to isolation and subsequent non-persistence in higher education” (Ellington, 2006, p, 27-28). In this spirit, these suggested reform initiatives are consistent with culturally relevant pedagogy, which has been shown to be highly effective among African American students (Ladson-Billings, 1995). From a socioicultural perspective, culturally relevant pedagogy may provide unique cultural activities whereby African Americans

and other minority students can learn mathematics effectively. As a result of these practices, African American students may positively associate mathematics with successful African Americans.

Family and Community Involvement

The established learning community within the classroom as well as the larger school, family and neighborhood environments must also provide the support necessary for the African American student to maintain a positive identity as a learner of mathematics and a positive sense of self as an African American student. These students must be provided with positive African American role models within their homes and communities. As evidenced from the results of this study, these role models and supporters often include parents. Community organizations should work to provide education and parenting skills for parents so that those without social and cultural capital can learn the necessary skills to better assist their children in their academic endeavors. In addition, colleges should look for ways to integrate parents into retention and student success programs targeting minority and African American students. By equipping parents with necessary parenting and mathematical skills, we can enhance the nature of parent-child interactions. From an emergentist perspective, this may increase opportunities for mathematical knowledge to be constructed and developed within these interactions.

Community members can also serve as role models, demonstrating examples of academic and mathematical success while encouraging students to gain additional mathematical knowledge. Community members and organizations can work to provide opportunities for students to work collaboratively in academic situations

outside of the classroom. These activities within the community can create additional opportunities for students to benefit from peer interactions in group study and collaborative learning. Examples can include after school peer tutoring, group projects involving mathematics and math-related field trips. Collectively, these efforts can assist in fostering an early interest in mathematics, increasing mathematical participation and subsequently, increasing the mathematical success of African Americans at the college level and beyond.

APPENDIX A: DEMOGRAPHIC (PRELIMINARY) QUESTIONNAIRE

Individual Data

Spring 2007

Dear participant, please complete this brief questionnaire by circling or checking the appropriate answers below. If you are uncomfortable sharing any information, please leave the question blank. We ask that you do not sign this questionnaire or identify the name of your institution or any other person.

1. What is your age? _____

2. What is your major or program of study? _____

3. When do you expect to graduate? _____

4. How many college credits have you completed thus far at the college?

5. Are you currently enrolled in a mathematics course this semester? _____

6. Which of the following best represents the mathematics course(s) you are currently taking?
- a) Calculus 1
 - b) Calculus 2
 - c) Calculus 3
 - d) Business Calculus
 - e) Statistics
 - f) Linear Algebra
 - g) Differential Equations
 - h) Other _____
7. How do you think you are doing in your current mathematics course?
- a) Excellent
 - b) Very Good
 - c) Good
 - d) Fair
 - e) Poor
 - f) Other _____
8. What racial group do you most closely identify with?
- a) White/Caucasian
 - b) Black or African American
 - c) Black or African American of Caribbean descent
 - d) Black or African American of African descent
 - e) Black or African American of Latin descent

- f) American Indian or Alaskan Native
- g) Hispanic or Latino Origin (non-Black)
- h) Asian
- i) Native Hawaiian or Pacific Islander
- j) Other _____

9. What is your country of origin? _____

10. What is your parent(s) country of origin? _____

11. Which of the choices below do you consider to be the most representative of your current household income?

- a) Less than \$10,000
- b) \$10,000-\$14,999
- c) \$15,000-\$24,999
- d) \$25,000-\$34,999
- e) \$35,000-\$49,999
- f) \$50,000-\$74,999
- g) \$75,000-\$99,999
- h) \$100,000-\$149,999
- i) \$150,000-\$199,999
- j) \$200,000 or more

APPENDIX B: PILOT INTERVIEW GUIDE

Note: The purpose of these interview questions is to understand each student's perception of mathematical success and the sociocultural, institutional and disciplinary factors that they perceive to directly impact their success in this area.

1. What is mathematical success to you?
 - When did you start feeling mathematically successful?
 - What made you feel successful?
2. What factors do you think have contributed to your success in mathematics? Please describe these factors in as much detail as possible.
3. How do you feel that each of these factors have directly contributed to your success in mathematics?

Additional Prompts (as needed):

4. Describe a particular experience that you have had during your college experience, that you think/feel has directly contributed to your success in your college mathematics courses?
5. Describe how you feel or perceive this experience to have directly impacted your mathematical success.
6. How have your peers, teachers or parents impacted your success in mathematics at the college level?
7. What role (if any) do you feel race has played in your ability to succeed in mathematics?
8. What factors do you feel have helped you to persist in the study of advanced mathematics?

9. Are there any other additional factors (not already discussed) that you feel have directly impacted your mathematical success at the college level? If so, describe these.
10. How do you feel or perceive that each of these additional factors have impacted your mathematical success?
11. What is your current occupation?
12. What are your future career goals or aspirations?

Question Feedback:

13. Did these questions make sense to you?
14. Did these questions allow you to express your feelings and experiences?
15. Are there any other issues that you wished to discuss that these questions did not address? If so, what are they?

APPENDIX C: INTERVIEW GUIDE

Note: The purpose of these interview questions is to understand each student's perception of mathematical success and various factors (e.g., sociocultural, institutional and disciplinary) that they perceive to directly impact their success in this area.

1. What is mathematical success to you?
2. When did you start feeling mathematically successful?
3. What made you feel successful?
4. What factors do you think have contributed to your success in mathematics at the community college level? Please describe these factors in as much detail as possible.
5. How do you feel that each of these factors have directly contributed to your success in mathematics?

Additional Prompts (as needed):

6. Describe a particular experience (or set of experiences) that you have had while attending community college that you feel has directly contributed to your success in your mathematics courses?
7. Describe how you feel this experience (or these experiences) to have directly impacted your mathematical success?
8. How do you feel your peers, older students, teachers or parents have impacted your success in mathematics at the community college level?
9. If you have had a mentor or mentors, how do you feel they have impacted your mathematical success at the community college?

10. Did you seek a mentor out, or did the mentor find you?
11. What role (if any) do you feel that race has played in your ability to succeed in mathematics?
12. What factors do you feel have helped you to persist in the study of mathematics?
13. What, if any, are the challenges that you feel have impacted your ability to succeed and persist in the study of mathematics? Discuss these challenges and how you may have managed to overcome them.
14. Are there any other additional factors (not already discussed) that you feel have directly impacted your mathematical success in college? If so, describe these.
15. How do you feel that each of these additional factors have impacted your mathematical success?
16. What are you career goals or aspirations?

APPENDIX D: INTERVIEW #2 FOLLOW-UP QUESTIONS (ADELLE)

1. On average, how many credits do you take every semester?
2. When do you expect to graduate/transfer from Community College One (CC1)?
3. When do you expect to receive your undergraduate degree?
4. Do you currently work?
5. Is your job full-time or part-time?
6. About how many hours per week do you work (on average)?
7. How long have you lived in the United States (US)?
8. Are you a U.S. citizen?
9. What are your parents' highest levels of education?
10. You mentioned that Nigerian parents are very strict when it comes to grades. How do you feel that coming from a different culture has impacted your mathematical success? Please feel free to discuss both positive or negative impacts as well as the fact that there may be no impact at all depending on your perceptions.
11. When asked about race, you described how Nigerian parents are very strict in regards to grades, etc. Do you feel that race has had any impact at all on your mathematical success?
12. How do you feel that race has impacted your success in mathematics?
13. You stated that when you were younger, you did poorly in mathematics and then you started to improve. Can you pinpoint something that directly contributed to your improvement in math?

14. You said that the teachers were helpful and were always able to answer your questions. Is there anything else that you would like to say about your teachers (community college professors) that may have contributed to your success?
15. You mentioned that your aunt helps you a lot with your mathematics and that you live with her. Aside from being there to answer your math questions, does she contribute directly to your mathematical success (or academic success in general) in any other way?
16. Whenever you came upon a difficult course or math concept in class, what types of things did you do to help you understand the course material?
17. In addition to peer tutoring in the math lab, you stated that your classmates/peers were a major factor which impacted your success in your college mathematics course. Can you talk more about this?
18. Were you involved in any study groups?

APPENDIX E: INTERVIEW #2 FOLLOW-UP QUESTIONS (ADRIANNA)

1. On average, how many credits do you take every semester?
2. Is your job full-time or part-time?
3. About how many hours per week do you work (on average)?
4. What are your parents' highest levels of education?
5. Overall, how do you currently see yourself as a student and “doer” of mathematics?
6. Community College One (CC1) has something called the math lab. It is a tutoring lab staffed by students and teachers who tutor students in math on a walk-in basis. Do you have something similar at Community College Two (CC2)?
7. Have you found it helpful to you while taking math courses here?
8. You mentioned that your grandfather is from Puerto Rico and your father is half Puerto Rican. How do you feel that culture has impacted your mathematical success? Please feel free to discuss both positive or negative impacts as well as the fact that there may be no impact at all depending on your perceptions.
9. You mentioned that you had the opportunity to take advanced mathematics courses prior to college that challenged you mathematically and prepared you well for college-level mathematics. Did you participate in a talented and gifted type of program?
10. How did your participation in this program come about?

11. You mentioned your fourth grade math teacher as someone who encouraged you, challenged you and helped you to develop a love of the discipline of mathematics. Was this teacher African American?
12. Do you feel that your educational experiences (elementary, middle, high school) adequately prepared you for mathematics at the college level?
13. What was the name of the highest-level mathematics course that you took at the high school level?
14. Whenever you came upon a difficult course or math concept in class, what types of things did you do to help you understand the course material?
15. Were you involved in any study groups?
16. You stated during our last interview that you wanted to become an international economist for a non-profit or non-government organization. Why specifically non-profit or non-government?
17. Is there anything else you would like to add about your community college math professors and their teaching?
18. During our first interview, you spoke about having to prove to your teachers that you could do the math. You perceived racism from your math professors as conveyed low expectations. Did you feel that you were in any way “representing for the race” as you performed well on your math tests and quizzes?

19. Do you feel that your resources (or lack thereof) as a member of the middle class have had any impact on your mathematical success at the community college?
20. In our first interview, you mentioned that you had to sacrifice being popular in some ways because you were interested in math at an early age when many of your peers were not. Were these peers African American?
21. How do/did you feel as an African American student doing well in mathematics?

APPENDIX F: INTERVIEW #2 FOLLOW-UP QUESTIONS (CHARITY)

1. On average, how many credits do you take every semester?
2. When do you expect to graduate/transfer from Community College One (CC1)?
3. When do you expect to receive your undergraduate (Bachelor's) degree?
4. Do you currently work?
5. Is your job full-time or part-time?
6. About how many hours per week do you work (on average)?
7. What are your parents' highest levels of education?
8. You mentioned that you wanted to do well because you did not want to waste your money. Are you paying for your own education?
9. How do you feel that finances have impacted your mathematical or academic success in college?
10. Why do you think you feel more comfortable asking questions in a predominantly White environment versus a predominantly Black environment?
11. How do you see yourself as a Black/African American student who is "excellent" at mathematics?
12. In our last interview, you mentioned that your mother/parents were from Nigeria. How do you feel that coming from a different culture has impacted your mathematical success? Please feel free to discuss both positive or negative impacts as well as the fact that there may be no impact at all depending on your perceptions.

13. You said that the teachers were helpful and were always able to answer your questions. Is there anything else that you would like to say about your teachers (community college professors) that may have contributed to your success?
14. Whenever you came upon a difficult course or math concept in class, what types of things did you do to help you understand the course material?
15. Overall, how do you currently see yourself as a student and “doer” of mathematics?
16. Do you feel that your educational experiences (elementary, middle, and high school) adequately prepared you for mathematics at the college level?
17. What was the name of the highest-level mathematics course that you took at the high school level?

APPENDIX G: INTERVIEW #2 FOLLOW-UP QUESTIONS (JAMES)

1. On average, how many credits do you take every semester?
2. When do you expect to graduate/transfer from Community College One (CC1)?
3. When do you expect to receive your undergraduate (Bachelor's) degree?
4. Do you currently work?
5. Is your job full-time or part-time?
6. During the school year, about how many hours per week do you work (on average)?
7. Are you a United States (U.S.) citizen?
8. You said that your parents were good at math and that you may have inherited a "math gene." What are your parents' highest levels of education?
9. How do your parents encourage or support your academic/mathematical success?
10. Describe a particular experience (or set of experiences) that you have had while attending community college, which you feel has directly contributed to your success in your mathematics courses?
11. You mentioned that in your elementary, middle school and high school there were many African American students that you knew who did well in mathematics. How do you feel that this knowledge impacted your ability to be successful in mathematics currently, at the community college level?

12. How do you feel that attending an all Black elementary school may have impacted your ability to succeed in college mathematics?
13. Do you feel that your educational experiences (elementary, middle and high school) adequately prepared you for mathematics at the college level?
14. Do you remember the highest math course you had at the high school level?
15. Would you say that you like mathematics as a discipline?
16. At what grade did you start liking mathematics?
17. Overall, how do you currently see yourself as a student and “doer” of mathematics?
18. How do you feel that being a descendant of parents coming from different cultures has directly impacted your mathematical success? Please feel free to discuss both positive or negative impacts as well as the fact that you may perceive there to be no impact.
19. Whenever you came upon a difficult course or math concept in class, what types of things did you do to help you understand the course material?
20. You mentioned that you had a good teacher for Calculus who was helpful when you needed help. Is there anything else that you would like to say about the teachers that may have impacted your success in a positive way?

APPENDIX H: INTERVIEW #2 FOLLOW-UP QUESTIONS (RAY)

1. On average, how many credits did you take while attending Community College One (CC1)?
2. Can you list the mathematics courses you have taken at the college level? Please include community college courses.
3. When do you expect to graduate from the university?
4. Did you work while attending CC1?
5. Was your job full-time or part-time?
6. About how many hours per week did you work (on average)?
7. How long have you lived in the United States (US)?
8. Are you a U.S. citizen?
9. What are your parents' highest levels of education?
10. Are you the first person in your family to attend college?
11. During our first interview, you talked about how you had to do well as an African American and a person from the Caribbean. How do you feel that coming from a different culture has directly impacted your mathematical success? Please feel free to discuss both positive or negative impacts as well as the fact that you may perceive there to be no impact.
12. You mentioned that when you did not qualify to sit for the math exam as a high school student in Jamaica, you could not go home and tell your mother that you didn't know enough mathematics to take the exam. Can you explain more about the role of your mother and/or your parents as it relates to your mathematical success at the community college?

13. During our first interview, you mentioned your strong background in mathematics prior to coming to the community college. Can you talk more about your math preparation in high school, elementary school, etc.?
14. You started liking math more when you had to work hard to prepare for the high school exam. What grade were you in when you started liking math?
15. Do you think there is a significant difference between the educational systems in the US versus Jamaica?
16. Overall, how do you currently see yourself as a student and “doer” of mathematics?
17. You talked about a connection that you felt with your Calculus teacher who understood where you were coming from as a Caribbean student. Can you talk more about this connection that you had?
18. How do you feel this connection may have directly impacted your mathematical success at the community college level?
19. You mentioned an “encouraging factor” which directly contributed to your success in mathematics. Was this encouraging factor your Calculus 1 teacher, your older friend who tutored you back in Jamaica, or something else? Please explain.
20. How do you feel that each of these factors directly contributed to your success in mathematics?
21. You also mentioned that as an African American student, things were difficult in the higher mathematics courses at the community college. Specifically, you

seem to have had difficulty getting your questions answered by some of your community college professors. Can you expand a bit more on this?

22. You describe that as an African American student, you felt it was your “job” to help other African American students in mathematics. Can you talk more about this sense of responsibility?
23. Whenever you came upon a difficult course or math concept in class, what types of things did you do to help you understand the course material?
24. You mentioned peer study groups and your peers as a contributing factor to your success. Can you talk more about this?
25. Were you involved in any study groups at the community college?

APPENDIX I: INTERVIEW #2 FOLLOW-UP QUESTIONS (TINA)

1. On average, how many credits did you take each semester while attending Community College One (CC1)?
2. When do you expect to graduate from the university?
3. During what years did you attend CC1?
4. Did you work while attending CC1?
5. Was your job full-time or part-time?
6. About how many hours per week did you work (on average) while attending CC1?
7. How long have you lived in the United States (US)?
8. Are you a U.S. citizen?
9. What are your parents' highest levels of education?
10. How do you think the challenge of having to work to help pay for your tuition may have impacted your mathematical success?
11. What would you consider to be your family's income (roughly) back home in Trinidad?
12. How do you feel your family's income level directly impacted your mathematical success at the community college, if at all?
13. You spoke very highly of your mother and the impact that she had on your academic success. Do you come from a single parent environment?

14. You mentioned that Uncle Dirk was a mentor who helped you out a lot with your mathematics coursework. Why do you think you felt more comfortable asking Uncle Dirk for help than your mathematics professors at the community college?
15. You stated that you were disappointed when you took the mathematics placement exam and you did not qualify for credit level math. You stated that this was a real surprise to you because in the Caribbean (coming from a British educational system), math is something that is taught seriously. Do you think there is a significant difference between the educational systems in the US versus Trinidad?
16. How do you feel that coming from a different culture has impacted your mathematical success? Please feel free to discuss both positive or negative impacts, as well as the fact that there may be no impact at all depending on your perceptions.
17. Did you feel that you had a strong math background coming into the community college?
18. Can you talk more about your math preparation in high school, elementary school, etc.?
19. At what grade level did you start liking mathematics?
20. Overall, how do you currently see yourself as a student and “doer” of mathematics?

21. You discuss personal drive and determination as major factors that attributed to your mathematical success at the community college. What do you think is the source of this drive and determination?
22. You mentioned that the math lab was a contributing factor to your success in math at the community college because you were able to review math concepts while helping other students. Did you receive much help from the math tutors in the lab as well?
23. How do you feel that those interactions with the math tutors contributed to your success?
24. Whenever you came upon a difficult course or math concept in class, what types of things did you do to understand the course material better?
25. You mentioned that your mother did not “feed you calculus for breakfast”. How do you feel that not having proper educational resources has directly impacted your mathematical success at the community college level?
26. You stated that you marked Black on the demographic questionnaire because you felt that was how society views you, even though you consider yourself to be “brown.” You also stated that in some ways, you identified with being the only Black female in your Calculus 2 class. How do you feel that your racial identity (how you identify yourself racially) has impacted your mathematical success at CC1?
27. In addition to peer tutoring in the math lab, you stated that your classmates/peers were a major factor which impacted your success in college mathematics courses. Can you talk more about this?

28. Were you involved in any study groups at the community college?

APPENDIX J: GROUP INTERVIEW GUIDE

1. I understand that Adrianna participated in a Talented and Gifted (TAG) program taking advanced classes beginning in middle school. Did any of you also participate in similar kinds of programs prior to college?
2. How does each of you feel that race has played out in your ability to succeed mathematically?
3. What is mathematical success to you?
4. What are the factors that you perceive to directly impact your mathematical success at the community college level?
5. How do you perceive these factors to directly impact your mathematical success?
6. Do you perceive hard work to be a factor that is directly attributable to your mathematical success?
7. If you perceive hard work to be a factor, please discuss the various ways in which hard work has led to your success?
8. Based on your mathematical experiences at the community college, what advice would you give to other Black/African American students or students in general who were studying mathematics at the college level?
9. If you had an opportunity to speak with faculty and administrators at your community college, what would you say to them?
10. Were any of you involved in the SASP program or Silas Craft Collegians Program?

APPENDIX K: TIMELINE FOR DATA COLLECTION AND ANALYSIS

1. Institutional Review Board (IRB) reviews proposal. (September, 2006)
2. Faculty committee reviews proposal. (November, 2006)
3. Final approval to start data collection is obtained from the faculty committee and IRB. (December, 2006)
4. Data are collected. (December, 2006 - July, 2007)
5. Data are analyzed. (December, 2006 - August 2007)
6. First draft of report is completed and submitted to faculty committee for feedback. (November, 2007)
7. Final draft is completed and defended before the faculty committee. (December, 2007)
8. Final document with revisions is submitted to the graduate school (December, 2007)

REFERENCES

- Abramson, P. R. (1992). *A case for case studies*. Thousand Oaks, CA: Sage.
- Abreu, G., & Cline, T. (2003). Schooled mathematics and cultural knowledge. *Pedagogy, Culture, and Society, 11*(1), 11-30.
- Ajayi, J. (1996, November). *The triple heritage revisited: Africanity, Islam, and the West*. Paper presented at the Annual Meeting of the African Studies Association, San Francisco, CA.
- American Institutes for Research (1998). *Gender gaps: Where schools still fail our children*. Washington, DC: Author. (ERIC Document Reproduction Service No. ED427390)
- Astin, A. W. (1964). Personal and environmental factors associated with college dropouts among high aptitude students. *Journal of Educational Psychology, 55*(4), 219-227.
- Astin, A. W. (1984). Student involvement: A developmental theory for higher Education. *Journal of Student Personnel, 25*(4), 297-308.
- Au, K., & Jordan, C. (1981). Teaching reading to Hawaiian children: Finding a culturally appropriate solution. In H. Trueba, G. Guthrie, & K. Au (Eds.), *Culture and the bilingual classroom: Studies in classroom ethnography* (pp. 139-152). Rowley, MA: Newbury.
- Bean, J. P. (1982). Conceptual models of student attrition: How theory can help the institutional researcher. In E.T. Pascarella (Ed.), *New directions for institutional research: studying student attrition, no. 36*. San Francisco: Jossey-Bass.

- Bean, J. P., & Metzner, B.S. (1985). A conceptual model of nontraditional undergraduate student attrition. *Review of Educational Research*, 55(4), 485-540.
- Bogdan, R. C., & Biklen, S. K. (1992). *Qualitative research for education: An introduction to theory and methods*. Boston: Allyn and Bacon.
- Bonsangue, M. W. (1992). The effects of calculus workshop groups on minority achievement and persistence in mathematics, science, and engineering (Doctoral dissertation, The Claremont Graduate School, 1992). *Dissertation Abstracts International*, 53, 3132.
- Bourdieu, P. (1986). The forms of capital. In J. G. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241-258). New York: Greenbook Press.
- Bourdieu, P., & Passeron, J. C. (1977). *Reproduction on education, society, and culture*. Beverly Hills, CA: Sage Publications.
- Boykin, A. W. (1986). The triple quandary and the schooling of Afro-American children. In U. Neisser (Ed.), *The school achievement of minority children: New perspectives* (pp. 57-92). Hillsdale, NJ: Erlbaum.
- Brand, B. R., Glasson, G. E., & Green, A. M. (2006). Sociocultural factors influencing students' learning in science and mathematics: An analysis of the perspectives of African American students. *School Science and Mathematics*, 106(5), 228-242.
- Breland, H.M. (1978). *Population validity and college entrance measures*. Princeton, NJ: Educational Testing Service.

- Brew, C. R. (2002, April). *Peer-interactions in the adult mathematics classroom and the flow-on effect to the children of women returning to study mathematics*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
- Bruner, J. (1990). *Acts of meaning*. Cambridge, MA: Harvard University Press.
- Bucci, T. T. (2002). Learning from experts: Relational stories and the textual assimilation of interchange. *Mid-western Educational Researcher*, 15(2), 32-36.
- Burdman, P. (2003). Taking an alternative route. *Black Issues in Higher Education*, 20(14), 32-34.
- Bush, E.C. (2004). Dying on the vine: A look at African American student achievement in California community colleges (Doctoral dissertation, The Claremont Graduate University, 2004). *Dissertation Abstracts International*, 64, 4326.
- Bush, E. C., & Bush, L. (2005). Black male achievement and the community college. *Black Issues in Higher Education*, 22(2), 44.
- Butcher, K (1994). Black immigrants in the United States: A comparison with native Blacks and other Immigrants. *Individual and Labor Relations Review* 47, 265-284.
- Chang, J. C. (2002). *Women and minorities in the science, mathematics, and engineering pipeline* (Report No. EDOJC0206). Washington, DC: Office of Educational Research and Improvement. (ERIC Document Reproduction Service No. ED467855)

- Chenoeth, K. (1998). The road not taken. *Black Issues in Higher Education*, 14 (26), 24-27.
- Cobb, P. (1994). Where is the mind? Constructivist and sociocultural perspectives on mathematical development. *Educational Researcher*, 23(7), 13-20.
- Cobb, P., & Yackel, E. (1995, October). *Constructivist, emergent, and sociocultural perspectives in the context of developmental research*. Paper presented at the annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, Columbus, OH.
- Cooper, J., Brandon, P., & Lindberg, M. (1997, March). *Using peer debriefing in the final stage of evaluation with implications for qualitative research projects: Three impressionist tales*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.
- Crawford, K. (in press). Cultural processes and learning: Expectations, actions, and outcomes. In P. Nesher, L. Steffe, P. Cobb, G. Goldin, & B. Greer (Eds.), *Theories of mathematical learning*. Hillsdale, NJ: Lawrence Earlbaum Associates.
- Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage Publications.
- Curtin, P. (1964). *The image of Africa: British ideas and action, 1780-1850*. Madison, WI: The University of Wisconsin Press.
- Curtin, P. (1974). The Atlantic slave trade, 1600-1800. In J. Ajayi & M. Crowder (Eds.), *History of West Africa* (pp. 240-268). London: Longman.
- DeSousa, J.D., & Kuh, G. D. (1996). Does institutional racism composition make a

- difference in what black students gain from college? *Journal of College Student Development*, 37(3), 257 -267.
- Doodoo, F.N. (1997). Assimilation differences among African Americans in America. *Social Force*, 76(2), 527-546.
- Education Trust. (2003). *Education watch: Maryland. Key education facts and figures. Achievement, attainment, and opportunity. From elementary school through college* (Report No. UD035760). Washington, DC: U.S. Department of Education. (ERIC Document Reproduction Service No. ED478548)
- Ellington, R. M. (2006). Having their say: Eight high-achieving African American undergraduate mathematics majors discuss their success and persistence in mathematics. Ph.D. dissertation, University of Maryland, College Park, United States –Maryland. Retrieved October 24, 2007, from Proquest Digital Dissertations database. (Publication No. AAT 3222482).
- Enright, S. M., & Axelrod, S. (1995). Peer tutoring: Applied behavior analysis working in the classroom. *School Psychology Quarterly*, 10(1), 29-40.
- Fan, X. (2001). Parental involvement and students' academic achievement: A growth modeling analysis. *Journal of Experimental Education*, 70(1), 26-61.
- Filipp, L. (2002). *Minority achievement report, 2002. Maryland community colleges, University System of Maryland, Morgan State University, St. Mary's College of Maryland* (Report No. HE035305). Annapolis, MD: Maryland State Higher Education Commission. (ERIC Document Reproduction Service No. ED469345)
- Filipp, L. (2004). *Performance of community college transfer students at Maryland*

public four-year colleges and universities Annapolis, MD: Maryland State Higher Education Commission. (ERIC Document Reproduction Service No. ED485489)

Flowers, L., & Pascarella, E. T. (2003). Cognitive effects of college: Differences between African American and Caucasian students. *Research in Higher Education, 44*(1), 21-49.

Fordham, S. (1988). Racelessness-a factor in students success: Pragmatic strategy or pyrrhic victory? *Harvard Educational Review, 58*(1), 54-84.

Fries-Britt, S. (1998). Moving beyond black achiever isolation: Experiences of gifted black collegians. *The Journal of Higher Education, 69*(5), 556-576.

Fullilove, R. E., & Treisman, P. U. (1990). Mathematics achievement among African American undergraduates at the University of California, Berkeley: An evaluation of the mathematics workshop program. *Journal of Negro Education, 59*(3), 463-478.

Gall, M. D., Gall, J.P., & Borg, W.R. (2003). *Educational research: An introduction* (7th ed.). Boston, MA: Pearson Education Inc.

Germain, C. B. (1991). *Human behavior in the social environment: An ecological view*. New York: Columbia University Press.

Gibson, M.A. (1991). Ethnicity, gender and social class: The school adaptation patterns of Indian youths. In M. A. Gibson & J.U. Ogbu (Eds.), *Minority status and schooling: A comparative study of immigrant and involuntary minorities* (pp. 169-203). New York: Garland.

Glazer, N., & Moynihan, D. (1963). *Beyond the melting pot*. Cambridge, MA:

University Press.

- Green, V. C. (2003). Cultural factors influencing the persistence of African-American community college students (Doctoral dissertation, Michigan State University, 2003). *Dissertation Abstracts International*, 64, 4327.
- Gutierrez, R. (2000). Advancing African American, urban youth in mathematics: Unpacking the success of one math department. *American Journal of Education*, 109(1), 63-111.
- Hackett, G. (1985). Role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis. *Journal of Counseling and Psychology*, 32(1), 47-56.
- Hackett, G., & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. *Journal for Research in Mathematics Education*, 20(3), 261-273.
- Hagedorn, L.S., Maxwell, W., & Hampton, P. (2001-2002). Correlates of retention for African American males in community colleges. *Journal of College Student Retention*, 3(3), 243-263.
- Harrell, P. E., & Forney, W. S. (2003). Ready or not, here we come: Retaining Hispanic and first-generation students in postsecondary education. *Community College Journal of Research and Practice*, 27(2), 147-156.
- Hart, L. E., & Stanic, G. M. A. (1989, March). *Attitudes and achievement-related behaviors of middle school mathematics students: Views through four lenses*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

- Hemmings, A. (2007). Seeing the light: Cultural and social capital productions in an inner-city high school. *The High School Journal*, 90(3), 9-17.
- Himelhoch, C.R., Nichols, A., Ball, S. R., & Black, L.C. (1997, November). A comparative study of the factors which predict persistence for African American students at historically Black institutions and predominantly White institutions. Paper presented at the annual meeting of the Association for the Study of Higher Education, Albuquerque, NM.
- Hoffman, K., Llagas, C., & Snyder, T. (2003). *Status and trends in the education of Blacks* (Report No. UD035929). Washington DC: National Center for Education Statistics. (ERIC Document Reproduction Service No. ED481811)
- Irvine, J. J. (1989). Beyond role models: An examination of cultural influences on the pedagogical perspectives of black teachers. *Peabody Journal of Education*, 66(4), 51-63.
- Jackson, L. R. (1996). Race and gender schema in the self-concept of African American College women (Doctoral dissertation, Stanford University, 1996). *Dissertation Abstracts International*, 57, 3417.
- Johnson, M. L. (1984). Blacks in mathematics: A status report. *Journal for Research in Mathematics Education*, 15(2), 145-153.
- Johnson, M. L. (1989). Minority differences in mathematics. In M. M. Lindquist (Ed.), *Results from the fourth mathematics assessment of the National Assessment of Educational Progress* (pp. 135-148). Reston, VA: National Council of Teachers of Mathematics.
- Johnson, T. L. (2001). Survival strategies of African American women in

- community colleges (Doctoral dissertation, University of Texas, 2001).
Dissertation Abstracts International, 62, 863.
- Katende, C. M. (1995). Population dynamics in Africa (Doctoral dissertation, University of Pennsylvania, 1994). *Dissertation Abstracts International*, 56, 1138.
- Klein, M (1993). Slavery and emancipation in French West Africa. In M. Klein (Ed.), *Breaking the chains: Slavery, bondage, and emancipation in modern Africa and Asia* (pp. 171-196). Madison, WI: University of Wisconsin Press.
- Krummheuer, G. (1992). *Lernen mit Format: Elemente einer interaktionistischen lerntheorie* [Learning with format: Interactionist learning theories for elementary school classes] . Weinheim, Germany: Deutscher Studien Verlag.
- Kuhn, M.H., & McPartland, T. S. (1954). An empirical investigation of self-attitudes. *American Sociological Review* 19, 68-76.
- Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, 32(3), 465-492.
- Levin, M. E., & Levin, J. R. (1991). A critical examination of academic retention programs for at-risk minority college students. *Journal of College Student Development*, 32(4), 323-334.
- Lewis, B. F. (2003). A critique of literature on the underrepresentation of African Americans in science: Directions for future research. *Journal for Women and Minorities in Science and Engineering*, 9(3 & 4), 361-373.
- Lewis, G. (1983). *Main currents in Caribbean thought: Society in its ideological aspects, 1492-1900*. Baltimore, MD: John's Hopkins University Press.

- Lewis, C. W., & Middleton, V. (2003). African Americans in community colleges: A review of research reported in the community college journal of research and practice. *Community College Journal of Research and Practice*, 27(9-10), 787-798.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.
- Littleton, R. A. (2001, November). *African American student persistence at small colleges in Appalachia: A qualitative study*. Paper presented at the annual meeting for the Study of Higher Education, Richmond, VA.
- Lubienski, S. T., & Shelley, M. C., II. (2003, May). *A closer look at US mathematics instruction and achievement: examinations of race and SES in a decade of NAEP data*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.
- Ma, X. (1999). Gender differences in growth in mathematical skills during secondary grades: A growth model analysis. *Alberta Journal of Educational Research*, 45(4), 448-466.
- MacKay, K. A., & Kuh, G.D. (1994). A comparison of student effort and educational gains of Caucasian and African American students at predominantly White colleges and universities. *Journal of College Student Development*, 35(3), 217-223.
- Martin, D. (2000). *Mathematics success and failure among African American youth: The roles of socio-historical context, community forces, school influence, and individual agency*. Mahwah, NJ: Erlbaum Associates.
- Martin, D. (2006). Mathematics learning and participation as racialized forms of

experience: African American parents speak on the struggle for mathematics literacy. *Mathematical Thinking and Learning*, 8(3), 197-299.

Martin, S. (1996, November). *Sociocultural factors affecting school culture for African American students: A case study*. Paper presented at the Annual Meeting of the National Association for Multicultural Education, St. Paul, MN.

Maryland State Higher Education Commission (1996). *A study of remedial education at Maryland public campuses* (Report No. HE030014). Annapolis, MD: Author. (ERIC Document Reproduction Service No. ED404971)

Maryland State Higher Education Commission (2003). *Maryland Higher Education Commission Data Book, 2003* (Report No. HE035792). Annapolis, MD: Author. (ERIC Document Reproduction Service No. ED475550)

Maton, K.I., & Hrabowski, F. H. (2004). Increasing the number of African American PhD's in the sciences and engineering: A strength-based approach. *American Psychologist*, 59(6), 547-556.

Maton, K. I., Schellenbach, C., Leadbeater, B., & Solarz, A. (2004). *Investing in children, youth, families, and communities: Strengths-based research and policy*. Washington, DC: American Psychological Association.

McClory, S. (2000, November). *Mathematics remediation in the California State University system: One campus' approach*. Paper presented at the annual meeting of the American Mathematical Association of Two-Year Colleges, Chicago, IL.

McJunkin, K. S. (2005). African Americans in community colleges. *Community*

College Journal of Research and Practice, 29(3), 251-256.

- Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (3rd ed.). Newbury Park, CA: Sage.
- Minick, J. N. (1985). L. S. Vygotsky and Soviet activity theory: New perspectives on the relationship between mind and society (Doctoral dissertation, Northwestern University, 1986). *Dissertation Abstracts International*, 46, 3397.
- Mohatt, G., & Erikson, F. (1981). Cultural differences in teaching styles in an Odawa school: A sociolinguistic approach. In H. Trueba, G. Guthrie, & K. Au (Eds.), *Culture and the bilingual classroom: Studies in classroom ethnography* (pp.105-119). Rowley, MA: Newbury.
- Moody, V. R. (2001). The social constructs of the mathematical experiences of African-American students. In B. E. Atweh, H. Forgasz, & B. Nebres (Eds.), *Sociocultural research on mathematics education: An international perspective* (pp. 255-276). Mahwah, NJ: Lawrence Earlbaum Associates.
- Moody, V. R. (2004). Sociocultural orientations and the mathematical success of African American students. *Journal of Educational Research*, 97(3), 135-148.
- Mooney, E. S., & Thornton, C. A. (1999). Mathematics attribution differences by ethnicity and socioeconomic status. *Journal of Education for Students Placed at Risk*, 4(3), 321-332.

- Morrow, V. (1999). Conceptualizing social capital in relation to the well-being of children and young people: A critical review. *Sociological Review*, 47, 744-765.
- Murphy, T. J., Stafford, K. L., & McCreary, P. (1998). Subsequent course and degree paths of students in a Treisman-style workshop calculus program. *Journal of Women and Minorities in Science and Engineering*, 4(4), 381-396.
- National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.
- National Science Board. (2002). *Science and engineering indicators* (Report No. NSB-02-1). Arlington, VA: Author.
- National Science Foundation, Where discoveries begin. (2004). *Women, minorities, and persons with disabilities in science and engineering* Retrieved July 10, 2007, from <http://www.nsf.gov>
- Nettles, M. T., Theony, A. R., & Gosman, E. J. (1986). Comparative and predictive analyses of Black and White college students' college achievement and experiences. *Journal of Higher Education*, 57(3), 289-318.
- Nettles, M. T. (1991). Racial similarities and differences in the predictors of college student achievement. In W. R. Allen, E. G. Epps, & N. Z. Haniff (Eds.), *College in Black and White: African American students in predominantly White and in historically Black public universities* (pp. 75-99). Albany: Erlbaum.
- Nettles, M. T. (1998). *Toward Black undergraduate student equality in American*

- higher education*. New York, Westport, Connecticut, London: Greenwood Press.
- Nora, A., & Cabrera, A. F. (1996). The role of perceptions of prejudice and discrimination on the adjustment of minority students to college. *Journal of Higher Education*, 67(2), 119-148.
- Oakes, J. (1990). Opportunities, achievement, and choice: Women and minority students in science and mathematics. *Review of Research in Education*, 16(1), 153-222.
- Ogbu, J. U. (1983). Minority status and schooling in plural societies. *Comparative Education Review*, 27(2), 168-190.
- Ogbu, J. (1985). A cultural ecology of competence among inner city Blacks. In M. B. Spencer, S. K. Brookins, & W. R. Allen (Eds.), *Beginnings: The social and affective development of Black children* (pp. 45-66). Hillsdale, NJ: Erlbaum.
- Ogbu, J. U. (1986). The consequences of the American caste system. In U. Neisser (Ed.), *The school achievement of minority children: New perspectives* (pp. 19-56). Hillsdale, NJ: Erlbaum.
- Ogbu, J. U., & Simons, H. D. (1998). Voluntary and involuntary minorities: A cultural-ecological theory of school performance with some implications for education. *Anthropology and Education Quarterly*, 29(2), 155-188.
- Ostine, R. (1998, Spring). Caribbean immigrants and the sociology of race and ethnicity: Limits of the assimilation perspective. *African American Research Perspectives*, 4(1), Article 10. Retrieved December 6, 2007, from <http://www.rcgd.isr.umich.edu/prba/perspectives/spring1998/rostine.pdf>

- Owen, E., & Sweller, J. (1989). Should problem solving be used as a learning device in Mathematics? *Journal for Research in Mathematics Education*, 20(3), 321-328.
- Pace, C. (1984). *Measuring the quality of student experiences*. Los Angeles: University of California, Higher Education Research Institute.
- Pascarella, E. T. (1982). *Validation of a theoretical model of college dropouts* (Report No. NIE-G-81-0057). Washington D.C.: National Institute of Education. (ERIC Document Reproduction Service No. ED221130)
- Pascarella, E. T. (1985). Racial differences in factors associated with bachelor's degree completion: A nine year follow-up. *Research in Higher Education*, 23(4), 351-373.
- Pascarella, E. T., & Terenzini, P. T. (1978). Student-faculty informal relationships and freshman year educational outcomes. *Journal of Educational Research*, 71(4), 183-189.
- Perna, L. W. (2000, April). *Racial/ethnic group differences in the realization of educational plans*. Paper presented at the annual meeting of the American Educational Research Association, Washington DC.
- Perna, L. W., & Titus, M. A. (2005). The relationship between parental involvement as social capital and college enrollment: An examination of racial/ethnic group differences. *The Journal of Higher Education*, 76(5), 485-518.
- Perry, T., Steele, C., & Hilliard, A. G. (2003). *Young, gifted, and Black*. Boston: Beacon Press.
- Phinney, J. S. (1992). The multigroup ethnic identity measure: A new scale for use

- with diverse groups. *Journal of Adolescent Research*, 7(2), 156-176.
- Powell-Mikle (2000, April). *Reflections on exemplary mathematics teachers by two African American students*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
- Powell-Mikle, A. (2001, April). *African American mathematic student perceptions of peers, education, and mathematical experiences*. Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA.
- Prager, J. (1982). American racial ideology as collective representation. *Ethnic and Racial Studies*, 5, 99-119.
- Reese, C. M., Miller, K.E., Mazzeo, J., & Dossey, J. A. (1997). *NAEP 1996 mathematics report card for the nation and states: Findings for the national assessment of educational progress*. Washington DC: Office of Educational Research and Improvement.
- Roach, R. (2005). Drawing upon the Diaspora. *Diverse: Issues in Higher Education*, 22(14), 38-41.
- Rogoff, B. (1995). Observing sociocultural activity in three planes: Participatory appropriation, guided participation, and apprenticeship. In J. Wertsch, P. del Rio, & A. Alvarez (Eds.), *Sociocultural studies of the mind* (pp. 139-164). Cambridge, UK: Cambridge University Press.
- Rong, X.L., & Brown, F. (2001). The effects of immigrant generation and ethnicity on educational attainment among young African and Caribbean Blacks in the United States. *Harvard Educational Review*, 71(3), 536-565.
- Rong, X. L., & Brown, F. (2002). Socialization, culture, and identities of Black

- immigrant children: What educators need to know and do. *Education and Urban Society*, 34(2), 247-273.
- Ross, S. I., & Jackson, J. M. (1991). Teachers' expectations for Black males' and Black females' academic achievement. *Personality and Social Psychology Bulletin*, 17(1), 78-82.
- Sampel, D. D., & Seymour, W. R. (1971). The academic success of Black students: A dilemma. *The Journal of College Student Personnel*, 12(4), 243-247.
- Shoenfeld, A. H., & Herrmann, D. J. (1982). Problem perception and knowledge structure in expert and novice mathematical problem solvers. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 8(5), 484-494.
- Silva, C. M., Moses, R. P., Rivers, J., & Johnson, P. (1990). The algebra project: Making middle school mathematics count. *The Journal of Negro Education*, 59(3), 375-391.
- Speight, S. L. (1996). Racial self-designation, racial identity, and self-esteem revisited. *Journal of Black Psychology*, 22(1), 37-52.
- Stanley, J.C., & Porter, A. (1969). A comparison of the predictability of academic success of Negro college students with that of White college students. *Journal of Educational Measurement*, 4, 199-218.
- Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, 69(5), 797-811.
- Stevens, F. (1995). Closing the achievement gap: Opportunity to learn, standards,

- and assessment. In B. Williams (Ed.), *Closing the urban achievement gap: A vision to guide change in beliefs and practice* (pp. 53-64). Philadelphia: Research for Better Schools.
- Stiff, L. V. (1990). African American students and the promise of the Curriculum and Evaluation Standards. In T. J. Cooney & C. R. Hirsch (Eds.), *Teaching and learning mathematics in the 1990's* (pp. 152-158). Reston, VA: Author.
- Stiff, L. V., & Harvey, W. B. (1988). On the education of black children in mathematics. *Journal of Black Studies, 19*(2), 190-203.
- Strutchens, M. E. (1993). An exploratory study of the societal and ethnic factors affecting sixth-grade African American students' performance in a mathematics class (Doctoral dissertation, University of Georgia, 1993). *Dissertation Abstracts International, 54*, 2084.
- Swigart, T. E., & Ethington, C. E. (1998). Ethnic differences in estimates of gains made by community college students. *Community College Journal of Research and Practice, 22*(8), 703-712.
- Swigart, T. E., & Murrell, P. H. (2001). Factors influencing efforts of gains made among African American and Caucasian community college students. *Community College Journal of Research and Practice, 25*(4), 297-312.
- Tate, W. F. (1994). Race, retrenchment, and the reform of school mathematics. *Phi Delta Kappan, 75*(6), 477-483.
- Tate, W. F. (1995). Returning to the root: A culturally relevant approach to mathematics pedagogy. *Theory Into Practice, 34*(4), 166-173.
- Terenzini, P. T., & Pascarella, E. T. (1980). Student/faculty relationships and

- freshman year educational outcomes: A further investigation. *Journal of College Student Personnel*, 21(6), 521-528.
- Thomas, C. L., & Stanley, J. C. (1969). Effectiveness of high school grades for predicting college grades of Black students: A review and discussion. *Journal of Educational Measurement*, 6(4), 203-221.
- Thompson, L. R., & Lewis, B. F. (2005). Shooting for the stars: A case study of the mathematics achievement and career attainment of an African American male high school student. *The High School Journal*, 88(4), 6-18.
- Tinto, V. (1975) . Dropout from higher education: A theoretical synthesis of recent Research. *Review of Educational Research*, 45(1), 89-125.
- Tinto, V. (1987). *Leaving college*. Chicago: University of Chicago Press.
- Tinto, V. (1998). Colleges as communities: Taking research on student persistence seriously. *Review of Higher Education*, 15(2), 109-127.
- Tisdell, E. J. (2000). Feminist pedagogies. In E. Hayes, D. Flannery, & Associates (Eds.), *Women as learners* (pp. 155-184). San Francisco: Jossey-Bass.
- Treisman, U. (1985). A study of the mathematics performance of Black students at the University of California, Berkeley (Doctoral dissertation, University of California, Berkeley, 1985). *Dissertation Abstracts International*, 47, 1641.
- Treisman, U. (1992). Studying students studying calculus: A look at the lives of minority mathematics students in college. *College Mathematics Journal*, 23(5), 362-372.
- United States Census Bureau. (2000). *Profile of selected economic characteristics*.

Retrieved July 10, 2006, from

http://factfinder.censUS.gov/servlet/QTTable?_bm=y&-geo_id=16000US2402275&-qr_name=DEC_2000_SF3_U_DP3&-ds_name=DEC_2000_SF3_U&-lang=en&-sse=on

United States Census Bureau. (2006). *USA statistics in brief-Race and Hispanic origin*. Retrieved July 15, 2006, from

<http://www.censUS.gov/compendia/statab/files/racehisp.html>

United States Department of Education; National Center for Education Statistics.

(2003). *Remedial education at degree-granting postsecondary institutions in fall 2000: Statistical analysis report* (Report No. NCES 2004-010).

Washington, D.C.: Author.

United States Department of Education; National Center for Educational Statistics.

(2004). *Trends in average mathematics scale scores by race/ethnicity: White-Black Gap*. Retrieved April 15, 2006, from

<http://nces.ed.gov/nationsreportcard/ltr/results2004/sub-math-race.asp>

United States Department of Education; National Center for Educational Statistics.

(2007). *Persistence and attainment of 2003-04 beginning postsecondary students: After three years* (Report No. NCES 2007-169). Washington D.C.:

Author.

Useem, E. L. (1990, April). *Social class and ability group placement in mathematics in the transition to seventh grades: The role of parental involvement*. Paper presented at the annual meeting of the American Educational Research Association, Boston.

- Van Oers, B. (in press) Learning mathematics as a meaningful activity. In P. Nesher, L. Steffe, P. Cobb, G. Goldin, & B. Greer (Eds.), *Theories of mathematical learning*. Hillsdale, NJ: Lawrence Earlbaum Associates.
- Vickerman, M. (1999). *Crosscurrents: West Indian immigrants and race*. Oxford, UK: Oxford University
- Von Destinon, H., Ganz, B., & Engs, M. (1993). Outcomes assessment and minority students in community colleges. *Community College Journal of Research and Practice*, 17(6), 497-508.
- Von Glasserfeld, E. V. (1995). *Radical constructivism: A way of knowing and learning*. *Studies in mathematics education series: 6*. London: The Falmer Press.
- Vygotsky, L. S. (1960). *Razvitie vysshikh psikhicheskikh tunktsii* [The development of higher mental functions]. Moscow: Akad. Ped. Nauk. RSFSR.
- Vygotsky, L. S. (1981). The genesis of higher mental functions. In J. V. Wertsch (Ed.), *The concept of mental activity in Soviet psychology* (pp. 144-188). Armonk, NY: M. E. Sharpe.
- Vygotsky, L. S. (1994). *Thought and language*. Cambridge, MA: M.I.T. Press.
- Watson, L.W., & Kuh, G.D. (1996). The influence of dominant race environments on student involvement, perceptions, and educational gains: A look at historically Black and predominantly White liberal arts institutions. *Journal of College Student Development*, 37(4), 415-424.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York: Cambridge University Press.

Wertsch, J.V. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.