

**Understanding the Mathematics Success of African-American Students at a
Residential High School**

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Abstract

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(Under the direction of Carol E. Malloy)

This dissertation is about the success of African-American students at a specialized, residential high school in the Southeastern United States. The following study investigates the impact of self-efficacy and social identity on the development of resilience and the resulting mathematics success of six African-American students at Caldwell Academy. Using phenomenology to convey the academic and social experiences of the participants, the analysis uncovers their self-perceived ability to be mathematically successful as well as the academic and social strategies contributing that success. Both high levels of self-efficacy and strong social support systems have contributed to their ability to be mathematically successful.

Research states that high-achieving African-American students use a variety of protective mechanisms and coping strategies to navigate difficult situations (Floyd, 1996; Lee, 1991; Steward, 1996), such as those reported by the participants. The results of this study can be used to develop practices for creating residential learning environments sensitive to the needs and unique challenges of African-American students, as well as to develop mathematics efficacy and strong social identities, both of which contribute significantly to academic resilience.

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Chapter 1: Introduction

This dissertation is about the academic and social strategies of mathematically successful African-American students. The participants in the study were successful in mathematics according to school standards, creating opportunities to enroll in higher level mathematics courses at Caldwell Academy, a specialized residential high school. Despite their eligibility, African-American students like the ones in the study historically have not enrolled in advanced mathematics courses at Caldwell Academy. As a segment of a student population comprised of high-achieving students, African-American students at Caldwell Academy did not have to negotiate between their academic and social environments. However, they were required to establish themselves as strong mathematics students; one such manner included advanced mathematics course enrollment.

By developing resilient attitudes African-American students are able to endeavor through difficult, and sometimes unfavorable, circumstances. For the students in the study, those conditions included academic adjustments and creating peer groups from the population of students with whom they both attended classes and shared residential experiences. The students worked through obstacles to their success by relying internally on their self-perceived

levels of mathematics ability and social support groups they constructed from their peers, family members, and school faculty and staff.

Statement of the problem

African-American students are underrepresented in science, technology, engineering, and mathematics (STEM) academic majors and careers. In entering the pipeline to such academic and occupational options, African-American students are not proportionally represented in many secondary courses (J. V. Clark, 1999; Ndura, 2003), particularly in mathematics, for which Algebra is considered a gatekeeper (Haury, 1999). At Caldwell Academy, a specialized, residential high school in the Southeast United States, the same disproportionate representation in higher-level mathematics courses exists for African-American students. African-American enrollment at the school for 11th and 12th grade students is considerably less than the African-American percentage of the population of the state in which it operates. This fact alone creates disproportionate enrollment statistics in many courses. Furthermore, even among these students with prior records of academic achievement, the rate of disproportion grows. African-Americans at Caldwell Academy are neither regularly nor proportionally enrolled in mathematics courses beyond the minimum department requirements. This under-representation in the student body and in higher-level mathematics courses combined with research reporting general feelings of inability to control personal situations by African-Americans (Hughes, 1989) can create a setting where students do not feel as confident in their abilities to be mathematically successful.

The creation of strong mathematics identity for African-Americans is not dependent on innate mathematical ability alone. Building mathematics identity for African-American students includes feeling confident about self-perceived mathematical ability, finding connections to the culture of mathematics, and having examples of successful African-Americans in mathematics (Hackett, 1989; Malloy, 1997; Moody, 2004). Teacher expectations of students can also impact the ways in which minority students approach mathematics in regards to their attitudes toward mathematics and course enrollment choices (Jamar, 2005; Rowser, 1994). In addition, as students in middle adolescence develop socially, the focus of their orientation may shift as a result of their changing priorities and identities. If maintaining ties to their social environment becomes more important, academically successful African-Americans have been found to downplay their academic achievements (Ogbu, 1987; Rowley, 2002). This type of downplay in the mathematics classroom can contribute to reduced connection to mathematics and academic achievement. It may also affect the mathematics course enrollment choices for students who choose peer acceptance instead of embracing academic performance and achievement.

The mathematics course options available to students at Caldwell Academy are increased when they prove successful in their junior year mathematics course. Students who enter the school enrolled in Precalculus and earn a final course grade of B- or higher are eligible to enroll in Calculus and other courses during their senior year; students who place into Calculus as juniors are immediately open to more mathematics options. Mathematically

successful students are able to choose not only Calculus and Statistics, but they may also enroll in mathematics electives such as Mathematical Modeling, Number Theory, and Combinatorics. Many of the mathematics electives, particularly those considered higher level courses, require strong talent and interest in mathematics. It is unclear whether minority students have little interest in mathematics, find other courses more relevant to their future plans, or doubt their abilities. Each of these possibilities is addressed in the current study. The bottom line is that eligible African-American students are not enrolled in higher level courses at Caldwell Academy and the reasons for the lack of minority enrollment in mathematics courses at Caldwell Academy are topics worthy of further investigation.

As the US population grows to include more people of color while US society and workforce become more demanding of mathematical literacy, the very minorities who are not demonstrating histories of mathematics identity will be left behind in industry and business. As NAEP reports a lag in the general mathematics education of African-Americans in grades 4, 8, and 12 (<http://nces.ed.gov>, 2005), the participants in the study have proven otherwise by establishing histories of mathematics achievement. At Caldwell Academy, one of the goals of the mathematics department is for students to learn to value mathematics. Other goals include developing students' confidence in their individual mathematics ability and using mathematics to solve problems as they are encountered daily. With the department goals following many of the *Principles and Standards for School Mathematics* as established by the National

Council of Teachers of Mathematics (NTCM, 2000), it is expected that the African-American students should be proportionately enrolled in higher level mathematics courses. African-American students with proven mathematics ability are not enrolling in courses which place them in academically advantageous situations.

Determining why African-American students are not enrolling in higher-level mathematics courses Caldwell Academy is not an easily solvable phenomenon because a variety of factors can affect course enrollment for African-American students, including, but not limited to post-secondary academic and career choices and general interest in and feelings about mathematics. The students in the current study have histories that inform their views and feelings about mathematics. Their developing social and racial identities also impact their mathematics involvement by influencing their priorities. As African-American adolescents have more experiences and gain more exposure to academic and career options, their preferences may change. The current study uses the words and experiences of mathematically successful African-American students to gain insight into all of these aspects of their mathematical and social identities, linking the two, and telling their stories. These are the stories of mathematically successful African-American students who, through their success, became exceptions to the stereotypical conceptions of mathematical underachievement and inability among African-Americans. Their stories also reveal why, despite their eligibility, they are not enrolling in higher-level mathematics courses. Their

words and experiences paint pictures, portraits of mathematically successful African-American students at Caldwell Academy

Purpose of the study

The purpose of the current study is to explore the various avenues of opportunity available for mathematically successful African-American students and the academic strategies employed by those same students at Caldwell Academy. The study also investigates how heavily related that success is to the development of social identity. The results of the study contribute to the body of literature about African-American students' experiences in mathematics by providing descriptions of the strategies used to be successful, and explaining the role that social identity plays in the orientation of the African-American students in the study, specifically within mathematics.

Research shows that the employment of informal and formal peer networks can contribute to the success of African-American students in specialized, independent learning environments (Datnow, 1997). Other studies show that African-American students select their personal peer groups based less on academic orientation than racial identity (Hamm, 2000); thus their stage of racial development influences their social circles. For many African-American students with histories of academic achievement there are at times competing influences between academic success and social acceptance (M. L. Clark, 1991; Fordham, 1986; Ogbu, 1987; Rowley, 2002). In the current study I investigated which dimension of student identity, if any, takes precedence for

mathematically successful African-American students in a specialized educational environment. Within the larger context of mathematics course enrollment at Caldwell Academy, this study attempts to answer the following research questions:

1. How confident do African-American students feel about their ability to successfully complete mathematics courses?
2. What academic and social strategies do mathematically successful African-American students employ?
3. What type of shift occurs in the development of racial and social identity of African-American adolescents at a specialized, residential high school?

Significance of the study

The number of state-supported and private specialized schools has grown since the inception of the nation's first school of this kind. Along with the growing minority population in the US comes change and accountability. The educational systems within each state are responsible for accommodating the growing minority populations with adequate preparation for post-secondary academic and career success. With ethnic diversity becoming an increasingly salient issue in education, business, economics, and politics, maintaining a positive educational atmosphere for all enrolled students is of growing importance.

The dearth of literature on the correlation between the formation of academic and racial identities for African-Americans in specialized learning environments has created a need for the current study and similar work. African-

Americans at specialized schools have records of academic achievement and are in the minority population, creating a learning scenario that has been seldom investigated. As African-Americans, students like the ones in the study belong to a group with demonstrated low levels of personal ability to affect change (Hughes, 1989), despite their mathematics achievement. As these students are incorporated into the academic community at schools like Caldwell Academy, they are also developing a sense of racial identity that changes with age, personal experience and exposure; stage of racial identity can also influence the ways in which students view education. Students at specialized schools must reestablish their academic presence while adapting to a residential environment requiring socialization. They also have to establish new social circles in light of their developing social identities, which are closely linked to racial identity for African-American students (Hamm, 2000). African-American students who possess positive racial identities are at an academic and social advantage over their less well-adjusted peers. Those with positive racial identities generally achieve at higher rates than those with less developed or negative identities and they are better able to choose peer groups based on levels of comfort (Wade, 2002).

The admission and enrollment goal at Caldwell Academy, a specialized, residential high school in the Southeast is for the student body to reflect the same racial and ethnic demographics of the state population. The 2000 US Census reported African-American population percentages of 12% nationally, and 21.6% in the state where the school resides. With a little over 600

students enrolled at the time of the study, there were approximately 70 African-American students at Caldwell Academy. Based on these figures, the African-American population at the school was approximately 11.6%, a greater disproportion than the state population. The same students populated their residential and academic lives of the students, making negotiation between the two environments almost non-existent. However, students at Caldwell Academy are faced with the challenge of re-establishing themselves as mathematically successful while creating social relationships outside the classroom with their peers.

A portion of the current study is a qualitative analysis of course-taking histories among African-American students graduating from Caldwell Academy from 2000 – 2004 to identify any trends. The results of the entire study develop a better understanding of the needs of African-American students with histories of mathematics achievement. This understanding will help develop strategies for encouraging students to become and remain successful, despite any external pressures that may be prevalent in their learning environments. The study also provides educators with information about the importance of academic orientation and racial identity to African-American students. With this information, administrators, teachers, and counselors can take steps towards encouraging the co-existence of both strong mathematics identity and positive racial and social identity.

As recently as 20 years ago, there would have been no applicability to the specific topics mentioned here. However, since the inception of the nation's first

specialized residential high school, other publicly-funded secondary institutions have been created in the country and around the world. There are also several privately funded specialized schools in which minority students may face the same set of challenges; thus, it is important to investigate the correlations between academic identity and racial identity to provide optimal learning environments for all students. Furthermore, with the under-representation of African-Americans in advanced and honors courses classes in public high schools nationwide, portions of the research may resonate in every school. Because both society and the work force are becoming increasingly technological and requiring various levels of mathematical literacy, it is important that all students are included in the American educational system.

Chapter 2: Review of the Literature

The development of racial and social identity in conjunction with academic identity, or lack thereof, for African-American adolescents has been examined by numerous researchers (M. L. Clark, 1991; Datnow, 1997; Fordham, 1986; Hamm, 2000; Mehan, 1994; Mickelson, 1990; Moody, 2004; Ogbu, 1987; M. B. Spencer, Noll, E., Stolfzfus, J., & Harpalani, V., 2001). Mickelson (1990) highlighted the discrepancy between high levels of self-esteem and significantly lower levels of academic achievement for many African-American adolescents. Others studies have explored the methods of disengagement for academically talented students who downplay their intelligence and academic achievement to maintain social status among their peers (Fordham, 1986; Ogbu, 1987). Research studies have frequently focused on the academic failures of African-American students and the ways they do not measure up academically or the pressure of choosing between academic orientation and social acceptance. The two are often presented as conflicting priorities for high-achieving African-Americans. The academic successes of African-Americans are rarely highlighted in the body of literature about African-Americans in middle adolescence. Few investigative studies exploring the possibility of achieving academic successes in the midst of socialization for African-Americans have been conducted until recently. As more studies of this nature have been published, researchers are

shedding light on the reality of being academically, specifically mathematically successful while developing healthy social identity (Chavous, 2003; Horvat, 2003; Moody, 2004; Rowley, 2002). For many African-American adolescents to be academically successful, they must develop strategies for coping with individual personality issues and unfavorable conditions within their home, community and schools (Floyd, 1996; Lee, 1991; Nettles, 1993; Steward, 1996).

For many African-American students to be mathematically successful they are required to persevere through difficult, and sometimes, unfavorable circumstances. This ability – academic resilience – requires many students to form strong mathematics identities in conjunction with healthy social identities. This dual formation and the resulting resilience of mathematically successful African-American adolescents can be addressed only by understanding the factors contributing to each. Here, mathematics identity development and social identity development are reviewed as factors contributing to the academic resilience of African-American students within academic settings and linked to establish the need for the current study.

First, literature about the factors contributing to the creation of strong mathematics identity is presented to outline the challenges and successes of mathematically talented African American students who are connected to the culture of the mathematics classroom. Next, studies investigating the development of social identity, which is strongly linked to the phase of racial identity for African-Americans, are reviewed to highlight the issues faced in adolescence. Finally, research on the process of developing personal and

academic resilience is reviewed to identify other factors contributing to academic success for African-American students.

Resilience serves as the primary framework for the review of the literature. The successful employment of formal interventions, protective mechanisms, and coping strategies contribute to the ability of African-American adolescents to achieve their academic and personal goals despite unfavorable conditions. Resilient students use coping strategies to deal with less than optimal circumstances and situations (Steward, 1996) and often employ the use of intervention programs to assist with successfully surmounting personal and academic obstacles (Nettles, 1993). Literature on general (personal) resilience provides an introduction to the mechanisms necessary for African-Americans considered at-risk to surmount obstacles. To specifically address academic resilience for African-Americans in middle adolescence, two major contributing factors – efficacy and social identity – are addressed. Within the scope the scope of this study, the connection between self-perceived academic ability and social identity as they contribute to personal and academic resilience in a residential setting is investigated. These secondary theories are reviewed first and then linked to serve as the foundation for the primary framework of academic resilience.

Bandura's model of efficacy and cognitive theory (1993) serves as a secondary framework for the review of literature. This model of self-perceived ability outlines contributing factors to students' varying levels of self-perception and the ways in which efficacy is exerted. Bandura's general model of efficacy

applied to mathematics establishes a relationship between students' self-perceived ability to be mathematically successful and the academic choices they make. Studies identifying the factors conducive to mathematics learning for African-Americans, such as connections to content area, inclusion in the culture of mathematics, and teacher expectations (Berry, 2003; Jamar, 2005; Malloy, 1997; Nasir, 2002; Rowser, 1994) are reviewed to further understanding about mathematically successful African-Americans. A premise based on blended theories of efficacy and mathematics success for African-Americans students serves as the major supposition of the proposed study.

Studies and research on efficacy and mathematics success were combined with literature on the formation of social identity for African-Americans to create research questions investigating the co-existence of both within the setting of a residential, specialized secondary school. Literature suggests that social identity for African-Americans adolescents varies as they progress through the various stages of racial identity development (Cross, 1991; Tatum, 1997). Cross's theory of *nigrescence*, the psychology of being Black¹, guides the secondary assumption of the study – social identity serves as a contributing factor to creating strong academic identity for African-Americans in middle adolescence. The relationship between peer group selection and development of social identity and race for African-American students (M. L. Clark, 1991; Hamm, 2000) is used to support the secondary hypothesis and significance of the study. The review of studies highlighting the employed strategies of

¹ At this point in the study, Cross' model introduces the term *Black* to refer to African-Americans; subsequent references to Cross' model and, later, participant voices will use the same terminology.

mathematically successful students and their social identities and orientation is incorporated to serve as informative pieces to the study.

The theories of perceived self-ability and social identity are used as factors contributing to the academic resilience of high-achieving African-American students. Studies investigating general resilience are examined, as well as those addressing the development of resilience within academic settings. Studies imply that resilient students possess certain personality characteristics (Floyd, 1996) and are exposed to positive influential factors within the community and their school environments (Nettles, 1993; Steward, 1996). The research on resilience is applied to the current topic and used to identify similar and contrasting themes among the participants.

Efficacy and Identity

Within general academics, and mathematics specifically, the confidence students have in their own abilities can affect their academic performance as significantly as the skills they possess (Bandura, 1986). This level of confidence – called self-efficacy – varies by academic ability and race, and is many times situation-specific. Efficacy is not so much the possession of a skill set and conceptual understanding as it is the judgment of what individuals can do with the skills they possess (Bandura, 1986). Self-efficacy has different ramifications in personal situations than it does in academic ones; self-efficacy can be used to predict academic outcomes (Pajares, 1994; Stevens, 2004). Several researchers have applied Bandura's social cognitive model of efficacy to

academics in general and mathematics, specifically. Other studies have furthered Bandura's research by investigating the sources of efficacy (Lopez, 1992), the levels of efficacy exhibited by various groups of students (Stevens, 2004), and the effects of efficacy on problem-solving approaches and persistence (Pajares, 1994). Efficacy theories have also been generated for personal levels of confidence affecting African-Americans in social, economic, and political situations (Hughes, 1989). They studies are presented as they relate to the mathematics success of students like the ones in the study.

Efficacy, the self-perceived ability to execute tasks to achieve certain outcomes (Bandura, 1986) has a significant effect on academic performance. Bandura found past performance, vicarious learning, verbal persuasion, and emotional arousal to be sources of efficacy for students. Each of these sources could positively affect efficacy when present, and, potentially, negatively affect it when absent. According to Bandura, efficacy exerts its influence through four major processes: cognitive, motivational, affective, and selection. Focusing on the cognitive model, levels of efficacy can affect academic performance and be used to predict it. In turn, efficacy can be influenced by past academic performance and one's conception of ability.

Students' aspirations, motivational levels, problem-solving approaches, and subsequent accomplishments are all determined by their beliefs in their own abilities. Levels of efficacy regulate learning, approaches to learning, and perseverance. Highly efficacious students visualize themselves as successful and use those success scenarios to guide their performance. Bandura notes that

highly efficacious students are more tenacious. They are more likely to be persistent when problem solving and able to employ multiple strategies when initial attempts are unsuccessful (Stevens, 2004). Their resilience is a result of their self-perceived ability to be successful in specific situations.

Hackett & Betz (2004) explored self-efficacy as it relates to mathematics to construct a mathematics self-efficacy scale (MSES). Following Bandura's lead, Hackett & Betz found mathematics self-efficacy to be situational and problem-specific. Students who believe they are mathematically capable may not feel able to successfully complete specific mathematics tasks or courses; thus, the scale used assesses students' confidence in completing examples or certain types of tasks rather than general mathematic concepts. Hackett & Betz used the MSES to examine the relationships between students' attitudes toward mathematics, mathematics self-efficacy, and mathematics performance. They found mathematics self-efficacy to be a strong predictor of student's attitudes toward mathematics, which in turn can influence academic and career choices. They also saw mathematics self-efficacy to be a stronger predictor of mathematics-related academic and career choices than past mathematics achievement or mathematics performance.

Efficacy for African-American students

There is a dearth of literature reporting the effects of efficacy on secondary academic performance for African-American students.. Self-efficacy, in general, for African-Americans has been reported (Hughes, 1989), as has the

correlation between efficacy and ethnic identity (O'Brien, 1999). Other theories have linked racial identity and academic and test performance (Fordham, 1986; Ogbu, 1987; C. M. Steele, 1997; C. M. Steele, & Aronson, J., 1995). Despite the existence of these studies, there are few studies specifically highlighting the relationship between mathematics self-efficacy for African-American adolescents in secondary education.

Hughes & Demo (1989) reported low levels of self-efficacy in African-Americans, but found high levels of self-esteem among the participants in their study. They explain this phenomenon by suggesting that self-efficacy and self-esteem are not related in Blacks, or that the low sense of personal efficacy is a result of larger social and economic systems of discrimination, not perceived self-worth. Hughes & Demo also suggest that efficacy increases with social class and education, rather than from an inherent sense of worth. The economic and social advantages that accompany higher-class status may create a greater sense of personal agency in African-Americans than the absence of economic prosperity.

Research has reported a difference between the attitude that African-American students possess about their self-perceived ability and their resulting performance in academic settings (Mickelson, 1990). Mickelson found that in an abstract sense, African-Americans embraced the dominant ideology of social mobility and increased opportunities resulting from education. However, the same African-Americans had contradictory concrete attitudes about education. Their feelings about education were strongly influenced by race, class, and

gender; these feelings were translated in to a belief that greater effort did not translate into increased educational rewards. Mickelson's results found that concrete attitudes about education more significantly contributed to grade point average (GPA), while abstract attitudes made no statistical contribution to GPA. This suggests that students' feelings about the education more strongly influence their academic performance than any ideology they choose to embrace.

O'Brien, Martinez-Ponz, & Kopola (1999) found that self-efficacy can be predicted by ethnic identity. In their study, they assessed mathematics self-efficacy, ethnic identity, and career interest in science and math, and then correlated the findings. Their results are solely based on these correlations and do not provide direct effects, only the degree to which one variable varies in relation to the next. There are no raw data reported on the differences in efficacy scores between ethnic or gender groups, only the degree to which they varied. This results of the indicate is a connection between mathematics self-efficacy and ethnicity, but provide very little information about what levels of efficacy can be expected from the subgroups of students in the study.

Stevens, et al. (2004) also investigated the differences in efficacy between racial groups and reported their findings. Although the group comparisons for that study were Caucasian and Hispanic, the study can be replicated for other groups in other educational settings. In that study, Hispanic students had significantly less confidence in their ability to successfully complete problems. The same study also found that students who attribute their success or failure in mathematics to factors such as prior mathematics achievement and motivation

perform better than those who directly attribute success to ability. These findings may be similar for African-American students, another under-represented group in STEM fields.

Steele reported that students' ability to perform well may be affected by what they perceive others to think of them (1995). Steele's theory of stereotype threat suggests that even the most talented African-American students are not able to perform well when presented with knowledge of academically inferior or deficient stereotypes about African-Americans prior to completing assessments (1995). Knowledge that one's racial group is perceived as inferior created pressure on an African-American student to perform negatively. In the face of such stereotypical images, the student's self-esteem was lessened, along with their perceived ability to successfully complete tasks.

Recent NAEP reports show that African-American students lag behind their White counterparts in assessments of mathematics performance for 4th, 8th, and 12th grades (<http://nces.ed.gov>, 2005).

Studies of the personal efficacy of African-Americans juxtaposed with studies on academic performance and participation in mathematics infer lower levels of academic and mathematics self-efficacy among African-Americans than among Caucasians. Low personal efficacy, resulting from larger social and economic systems beyond the control of African-Americans, can trickle down into the academic efficacy of African-American students. The lack of perceived ability to control and navigate situations both inside and outside the classroom, may possibly translate into poor academic achievement. To mitigate the effects of

low efficacy levels, classroom environments and educational institutions must incorporate the learning and culture of all students, not just African-Americans, into the classroom before students are able to find relevancy in course content and problem-solving.

From the literature, I posit that all students at specialized schools must effectively, start from the beginning in creating self-concept and perceived ability to be successful in mathematics. Upon enrollment, students are in a new academic environment where their records of academic achievement must be re-established. However, for African-American students at Caldwell Academy, a different set of challenges is created by enrolling in a high school where the African-American student population barely reaches double digit percentages. Although many students do not easily make the transition into the open-ended nature of the curriculum at Caldwell Academy, African-American students potentially face a different set of challenges and obstacles to adjustment based largely on their minority status.. All students enrolled at specialized schools are longer considered unique as they are brought together with students of comparable abilities,. African-Americans then may become products of race, class and socio-economic status (SES), which in turn can affect their sense of self-efficacy. In an academic setting, this lack of personal efficacy can affect the sense of control and ability students perceive themselves to possess in the mathematics classroom.

Most African-American students in the current study did not enroll in higher level mathematics courses. Their records of mathematics achievement

and/or mathematics performance during their first year at Caldwell Academy expanded their mathematics course options during their senior year, but few took advantage of their increased opportunities. The literature prompts exploration into the students' levels of confidence about their past and current ability to be mathematically successful. The current study investigates this relationship particularly as it pertains to completing mathematics courses at Caldwell Academy. The level of increased education available at specialized schools like Caldwell Academy creates an expectation of increased general self-efficacy among the African-American students enrolled. Because African-American students historically were not enrolled in higher level mathematics courses, the study also investigates the attitudes African-Americans at Caldwell Academy held toward mathematics, its usefulness, and their ability to do well with increased effort.

Mathematics and African-American Students

Creating strong mathematics identity for African-American students is not simply the possession of sufficient innate ability and high levels of mathematics efficacy; this is true of all students. African-American students must also create connections to the culture of mathematics (Malloy, 1997) . In general, students must find connections between their values, priorities, and abilities and those of the other culture before identifying with that culture. For African-Americans students, those connections to the culture of mathematics are established by the presence of successful examples of African-Americans in mathematics (Moody,

2004) and demonstrated relevance of mathematics to their lived experiences. Additionally, the active support of teachers of mathematics through verbal persuasion can also positively affect African-American students' attitudes toward mathematics (Jamar, 2005; Lopez, 1992; Rowser, 1994; Stiff, 1988).

The past few NAEP assessments have shown that African-American students lag behind their White counterparts in 4th, 8th, and 12th grade mathematics performance (<http://nces.ed.gov>, 2005). Additionally, the percentage of 12th grade students who perform at or above acceptable proficiency levels is lower than that of 4th and 8th grade students, suggesting a decrease in secondary mathematics performance levels for African-American students. If connecting to a culture, in this case that of mathematics, is necessary before creating a mathematics identity (Malloy, 1997; Nasir, 2002), African-American children are not making the necessary connections to the language, procedures, and conceptual understanding of mathematics. Cultural relevance, prior mathematics experience and courses, the availability of role models, and the influence of others significant to the students are all contributing factors to the level of engagement African-American students exhibit in the mathematics classroom (Jamar, 2005; Malloy, 1997; Moody, 2004; Rowser, 1994; Stiff, 1988).

Research shows that the structure of many mathematics classrooms can be exclusionary to African-American students (Malloy, 1997; Stiff, 1988). Studies have found that African-Americans tend to be holistic, field-dependent learners who benefit from working cooperatively and solving problems based on assumptions made in their lives. Because students learn through their own

cultural interpretation, the relevance of mathematics to their lived experiences and post-secondary aspirations is important. Feelings of being disconnected, and not understanding the usefulness of what is presented, can affect a student's desire to participate in the mathematics classroom, thus promoting or inhibiting their feelings of inclusion in the process of learning and knowledge construction in mathematics. The cooperative learning and holistic approach of many African-American students is met with independent work and analytical problem-solving in some mathematics courses. Malloy argued that students may become engaged in mathematics once they become enculturated in mathematics (1997). At that point, they learn to think mathematically and take on the values of the mathematics community. However, with the diversity of student populations, teachers must also present lessons in such a manner that students find connections.

Recognizing diversity in the classroom, the National Council of Teachers of Mathematics created *Principles and Standards of School Mathematics*, a set of standards emphasizing teaching that facilitates the development of conceptual understanding, discovery of mathematical relationships, and knowledge construction (2000). Of particular relevance to this study are the Equity Principle and Communication and Connections Standards. NCTM's Equity Principle dictates the communication of high expectations and strong support for *all* students, particularly those from under-represented populations. Low mathematics performance is expected of such students. NCTM also addresses the needs of exceptional students. Exceptional students must be guided to excel

in mathematics through nurturing their talents and interests. Equity in the classroom, then, ensures that students participate in mathematics classrooms with substance, where their presence and ideas are valued; classrooms where they are given the necessary tools and encouragement to perform.

Once students are encouraged to meet the expectations that have been established, the Communication and Connections Standards allow them to share their knowledge with others and apply mathematical knowledge to other areas. The Communication Standard requires that students learn to communicate their mathematical understanding both inside and outside the classroom, while the Connections Standard necessitates the application of mathematics to contexts outside of mathematics.

Teaching mathematics by the NCTM Principles and Standards can help students learn to recognize mathematics in their lived experiences, expanding the applicability of learned concepts and methods beyond the classroom. It is critical that students create a type of mathematics literacy that is not exclusive to a classroom setting (Cobb, 2004), which is possible through conceptual learning.

Demonstrated relevance of mathematics in lived personal, academic, and career experiences can positively influence student engagement in mathematics. Because mathematics classrooms often are oft perceived as exclusionary by many African-Americans, relevance is of more importance. Not only under-represented in higher level mathematics courses at Caldwell Academy, African-Americans are generally underrepresented in STEM fields (Haury, 1999). Students are more motivated and likely to pursue mathematics when they have

examples of successful African-Americans in fields requiring mathematics literacy (Bonner, 2003; Moody, 2004; Stiff, 1988). An evaluative study by Eatmon, Jay, & Frierson (2003) found that African-Americans are encouraged to pursue science & mathematics-based graduate degrees when they are able to witness the existence of others with the same racial and cultural background possessing such degrees. The findings of the study may be relevant for African-Americans in residential secondary schools, as well.

Teacher support, interaction, and expectations can also influence one's interest or perceived ability to be successful in mathematics (Jamar, 2005; Lopez, 1992; Moody, 2004; Rowser, 1994). Within the classroom, teachers' responses to students' problem-solving methods and participation can either encourage or destroy a student's interest in mathematics (Stiff, 1988). Rowser (1994) reports teacher expectations of students can influence student's self-expectations and attitudes toward learning. To assist in creating strong mathematics identity, the mathematics classroom must provide equitable opportunities for higher level learning and expectations for all students. Through expressing high expectations of minority students, in conjunction with applying the NCTM Principles and Standards (2000), minority students will be included in the mathematics community and feel connected to mathematics (Jamar, 2005). Teachers are also influential in referring students to gifted programs and advanced mathematics courses, exercising their contribution students' post-secondary educational and occupational options. In addition, when serving as

role models, mathematics teachers heavily influence student interest in mathematics.

Although race does not directly influence self-efficacy, it can be used for prediction (Stevens, 2004). In addition to efficacy, students need to make connections to the culture of mathematics to feel part of the mathematics community and able to succeed. The need for further investigation into the efficacy levels of all African-American students, particularly those in specialized learning environments, is necessary to create productive learning environments for the growing diversity of student populations nationwide.

African-American students at specialized schools have proven academic track records supporting their innate cognitive ability. The students' prior performance in mathematics has been demonstrative of some type of connection to the methods and procedures used in mathematics.

Social Identity

Social identity is the result of associating characteristics, activities, and other items to collectively define a person (Wortham, 2004). These items include, but are not limited to sexual orientation, religious affiliation, family values and racial identity. Social identity may also include the role(s) an individual assumes. For adolescents in school, those roles may include "athlete" and "good student" (Wortham, 2004). The social identity of African-American children often includes their race and is deeply rooted in the development of their racial identities (Tatum, 1997). As African-American adolescents and adults progress

through the various stages of racial identity development, their social affiliations and activities may change (Cross, 1991), as will their resulting social identity. In the context of schools and educational environments, adolescents create relationships and friendships within those settings (Hamm, 2000; Tatum, 1997). Similarities on dimensions such as race and academic orientation help children forge social and academic relationships. Minority students, particularly African-Americans, may find their cultural and lived experiences do not support an ideology of achievement and meritocracy (Mehan, 1994; Mickelson, 1990) presented in schools. Thus, the development of identity can become complex and difficult to negotiate for African-Americans.

Racial Identity Development

The link between social identity and racial identity requires an understanding of the role race plays in self-identification for African-American adolescents. To address this aspect of identity, Cross's model of *nigrescence*, the psychology of being Black (1991), is reviewed and presented as the theoretical model for racial identity development. Understanding the nigrescence model provides insight into the stages of development into which many African-American adolescent students fall. In *Shades of Black* (1991) Cross established five stages of nigrescence after reviewing studies about racial identity and the psychology related to racial identity development. Early 20th century theories focusing on African-American self-hatred – embracing the White American, mainstream ideology and rejecting ideas and behaviors associated to being

Black – shifted to the investigation of positive identity formation during the Civil Rights and Black Power movements of the 1960s – opportunities for emphasis on Black nationality.

Nigrescence posits five stages during which the salience and effects of race vary for African-Americans (Cross, 1991). The stages, preencounter, encounter, immersion/emersion, internalization, and commitment accompany the changing centrality of race as African-Americans develop racially. With each stage, the salience of race changes, resulting in varying social, educational, and political choices made by African-Americans. As children grow and become exposed to larger social and economic systems, they also progress through identity development.

The first stage of nigrescence is called *pre-encounter*. People at this stage are generally satisfied with and do not question the values and images that are part of the dominant society, in this case White America. At this point, race is not as significant as other aspects of one's self-concept may be. This can be seen in the way young children will play with others regardless of race and gender.

There is disagreement among scholars about the age at which African-Americans progress to the second stage of nigrescence, *encounter* (Cross, 1991; Tatum, 1997). Although Cross suggested that it does not occur until late adolescence and early adulthood, Tatum argues that as early as middle and junior high school, African-American children are placed in situations where race is an issue for them. During adolescence, most children begin to recognize

differences and ask themselves questions about their sexuality, popularity, and identity. During the encounter phase is when African-Americans are faced with the stereotypes, discrimination, and expectations that accompany being Black in America.

Whether the encounter is positive or negative, African-Americans move from encounter to enter *immersion/emersion*. During immersion one associates with all things Black and begins to reject what is valued in White society. Children and adults in immersion not only define themselves externally to prove their “Blackness” to the world, but also challenge the Blackness of others. African-Americans in immersion join primarily or exclusively African-American social, political, and religious organizations (Cross, 1991). They limit interaction with whites and generally fall into the stereotype of the militant African-American who accuses Whites of being evil and the cause of many problems African-Americans face.

As African-Americans learn about and accept both positive and negative images, they move on to *internalization* and incorporate the many facets of “Blackness” into their individual identities and self-image. Tatum (2003) found that some students who did not progress to this stage until they were in college and had the opportunity to learn about African-American history and culture through classes that were not offered in high school. Others progress to internalization through cultural exposure by other methods. .

By the time individuals reach commitment, they no longer feel the need to prove their Blackness and are even able to incorporate some aspects of the

dominant culture into their own values. Cross (1991) found that some of the same items that were of value to pre-encounter African-Americans were shared by African-Americans in the internalization/commitment stage. Though the values were the same, the rationale for acceptance was different. Pre-encounter African-Americans were subject to believing things associated with White society were right, by virtue of White society being right. However, African-Americans in internalization/commitment accepted those values as being necessary for success.

Not all African-Americans will progress through the stages of nigrescence as determined by Cross. However, as African-Americans adolescents create their social identities, most undoubtedly go through some type of racial identity development. Cross' model is offered as one theory of racial development.

To develop a comprehensive model of the multi-faceted nature of racial identity, Sellers, Smith, Shelton, Rowley, & Chavous (1998) developed the Multidimensional Model of Racial Identity (MMRI). This model attempts to combine the universal properties associated with racial and ethnic identities with the qualitative meaning of being African-American. The model uses four dimensions of identity – salience, centrality, regard, and ideology – and how they each influence individual behavior to investigate the formation of identity among African-Americans. In the model, salience is the degree to which one's race is of importance to self-concept. Salience varies among individuals and across situations, unlike other dimensions of identity. Centrality, one's racial self-definition, is relatively stable, and is at the core of many models of social, racial,

and ethnic identity. Regard addresses one's judgment of his/her race and is comprised of both private and public regard. Private regard is the way each participant feels about being African-American. Public regards refers to the way one feels others think about African-Americans.

Ideology encompasses the beliefs and opinions about the way one feels African-Americans should act. Four types of ideologies have been identified – nationalist, oppressed minority, assimilation, and humanist. The nationalist ideology focuses on the African-American experience. As a nationalist, one believes that African-American should be self-reliant and unite to achieve goals. One who exhibits characteristics of the oppressed minority ideology finds commonalities among African-Americans and other minorities in the United States. The assimilation ideology focuses on the commonalities between all Americans. An African-American with an assimilation ideology tries to work within the mainstream American system to change it instead of adopting an oppositional stance. A humanist ideology finds commonalities among all human beings. The humanist sees others as people first, most likely resulting from a strong religious or spiritual belief that ties individuals together. Although many African-Americans have a high score on only one type of ideology, it is possible for one to exhibit characteristics of more than one ideology.

The four dimensions of the MMRI can be used to collectively define racial identity for African-Americans. The model captures the heterogeneity of African-American experiences and uncovers the aspects of racial identity that strongly influence individual actions and decisions. Sellers, Smith, Shelton, Rowley, &

Chavous (1998) used the MMRI to develop the Multidimensional Inventory of Black Identity (MIBI). The MIBI is a 56-item assessment that quantitatively captures the three relatively stable dimensions of identity; a subscale score for each dimension is created by averaging Likert responses to the set of questions addressing that particular dimension. The researchers found the MIBI to be a valid measure of the MMRI. The MMRI and MIBI can be used to explore the developing racial identities of African-American adolescents.

From the literature, I posit racial identity largely drives the social identity of African-American adolescents. African-American children are often unaware of race; they forge friendships with classmates and neighbors – those to whom they have access. However, as they are more exposed to society, race becomes more salient to them, just as it does to society (Tatum, 1997). As adolescents progress through the stages of nigrescence, their definition of self may be externally or internally defined. Children who have not formulated a positive racial identity are often not able to function well in larger society and do not consciously incorporate mainstream American values into their value system. They also may not be successful at negotiating between their academic and social institutions. Those who internalize a positive racial identity are better able to perform academically and buffer acts of discrimination and racism (Moody, 2004).

Social Identity Development for African-Americans

The development of social identity and the socialization process are deeply rooted in racial identity development for African-Americans. The ability to negotiate between what may be unrelated academic and community experiences causes adolescents to create bicultural views, coping mechanisms, and survival strategies (Moody, 2004; Rowley, 2002). In academic and community environments students create relationships with other students, family, and friends. To thrive in both environments, they must be able to participate in academic activities, mostly representing mainstream values, and cultural and community activities, concrete manifestations of their realities (Mehan, 1994; Moody, 2004). Both inside and outside schools, students create social circles and personal peer groups from the larger group based on similarities (J. V. Clark, 1999; Hamm, 2000; Wade, 2002).

Within the context of schools, racial identity can become significant for African-American adolescents (Tatum, 1997). In the middle grades, students begin to be separated into groups based on academic ability and academic orientation. However, as Tatum argues, the minority status of African-American students remains despite class placement and academic status. Identifying commonalities among peers can give students the basis for developing friendships and personal peer groups. The personal peer groups they choose may be based on several types of similarities including academic orientation, racial identity, religion, and common activities and interests (J. V. Clark, 1999; Hamm, 2000; Tatum, 1997; Wade, 2002).

Hamm (2000) found that peer groups were selected based on a variety of factors including ethnic identity, personal values, and academic orientation. The findings from the study indicated that similarities in ethnic identity were greatest among African-American adolescent peer groups. Sharing common ethnic and racial identity was a stronger influence in peer groups selection than academic orientation or personal values. She also found that each ethnic group in the study emphasized different dimensions when choosing peer groups; African-Americans students in the study chose peer groups with strong regard to ethnic identity and were less like their friends in regards to academic orientation.

Tatum (2003) argues that African-American kids “sitting together in the cafeteria”, where they share their experiences and find comfort by being with others who have similar backgrounds, is precipitated by some type of racial encounter. For African-American students, such an encounter can force students to recognize the salience of race in society, making ethnic differences and similarities more obvious than other aspects of social identity such as academic orientation and political and religious affiliation.

For African-Americans, race becomes salient during adolescence and greatly contributes to their developing social identities. Race may not determine the many facets of one’s social identity, but can impact them. The centrality of race to students’ identities, and their phase of racial development, can influence the degree to which they assume roles in school, choose activities, and actively practice religious and political activities. For adolescents in the immersion/emersion phase of racial development, their external orientation will

lead them to define themselves by proving and asserting their “Blackness.” This may come in the form of creating all-African-American peer groups at home and in school and rejecting the concepts and values of mainstream (White) American society. However, it is possible for students possessing both high and low levels of centrality with respect to race, yet maintain healthy self-identity (Chavous, 2003). African-American students are also able to adjust socially and embrace their academic achievement when they possess a bicultural view – dual existence in African-American culture and mainstream educational environments (Rowley, 2002). This suggests that regardless of racial centrality, students with healthy self-identity are better able to incorporate peers from diverse cultural backgrounds into their social circles and affiliations than those without healthy self-identity.

In addition to their mathematics identities, African-American adolescents have developing social identities that are deeply rooted in how they identify in terms of race and culture. Like many high-achieving African-Americans, the students at Caldwell Academy must grapple with their academic and social identities, which may seem disjoint and, at times, oppositional. The students in the current study were African-Americans in middle adolescence, secondary students on the brink of high school graduation and adult life. Literature suggests they had experienced some type of racial encounter and had progressed to the immersion/emersion or internalization phases of nigrescence by the time they enrolled at Caldwell Academy. Their stage of nigrescence and

dimensions of racial identity are interpreted based on their responses to the data collection procedures, which are outlined in the next chapter.

Socially, the participants in the study lived among the same students with whom they attended classes. They were able to extend any relationships from the classroom into their residential lives, as well as invite individuals outside of class with whom they shared other similarities into their social circles. Assuming academic orientation was embraced by all students at Caldwell Academy, participants in the study were able to choose their social circles based on the facet of their identity which was most important for them.

Resilience

Resilience is most often presented by researchers as the employment of intervention programs, protective mechanisms, and/or coping strategies to mitigate the effects of unfavorable conditions and circumstances (Floyd, 1996; Nettles, 1993; Steward, 1996). For academically successful African-American students, resilience has been investigated as coping strategies for achieving students in environments where African-American success is not the norm or highly regarded by peers (Floyd, 1996; Steward, 1996). The mathematical success of African-American students at specialized schools depends on the development of academic and personal resilience. As residential students, the the study participants were not subject many of the negative factors affecting the academic success of other African-Americans, but enrollment at such schools

presented a different set of challenges and obstacles for a high-achieving student.

Nettles & Pleck (1993) provide a strong foundation for resilience development. Their research reviewed intervention programs and protective factors as they contributed to the process of developing personal and academic resilience for at-risk youth. The risks included teen pregnancy, dropping out of high school, alcohol and substance abuse, gang participation, and other violent behaviors. The researchers discussed both individual and community-level risk factors that could impede personal, economic, and academic success. Individual risk factors included personality, socio-demographic factors and problem behaviors such as sexual activity and drug/substance use/abuse. Community-level risk factors included neighborhood demographics, school characteristics, physical settings, community climate, and issues of racial discrimination. Poor health, sexual activity, drug and alcohol use, increased high school dropout rates, and low employability were among the reported outcomes from the lack of resilience.

Protective factors contributing to academic resilience for African-American adolescents were reviewed as a small piece of the Nettles & Pleck report. Resilient students were found to have close friendships, perceptions of school environments as supportive and active parental support. Exposure to mainstream culture and possession of a strong bi-cultural identity in conjunction with a positive racial identity were characteristics of academically resilient students. This suggests that students who have developed racially and socially

are able to translate positive influences and relationships into their academic experiences and resulting academic success.

The academic success of African-American adolescents from impoverished backgrounds was the focus of a resilience study by Floyd (1997). The research consisted of conducting interviews with 20 academically successful African American seniors in an urban California high school to identify internal and external factors contributing to resilience. Floyd identified the following positive contributors to resilience: supportive home environment, relationships with concerned educators and adults, and favorable personality traits such as perseverance and optimism. The existence of a positive parent-child relationship gave at-risk students encouragement and often motivated students to work hard. School counselors, teachers, and other adults with whom the students regularly come in contact served as positive role models and mentors for students. When the diversity of school personnel was a reflection of the school population, these adults often acted as a liaison between the students' home and school communities and positively relate to the student. For the students in Floyd's study, this created connections to school and the larger educational system. Lastly, Floyd found that students with a strong sense of perseverance worked through problem situations and felt more able to control the outcome of many situations.

Lee, Winfield, & Wilson (1991) also investigated the academic behaviors of African-Americans students considered at-risk who demonstrated high levels of academic performance. Middle grades students with scores above the

national average in reading achievement were compared with lower achieving peers to determine what factors such as family backgrounds, school characteristics, and academic behaviors contributed to the variance in reading achievement. Middle grades students were used to avoid the complications associated with drop-out rates once students reach high school and education is no longer compulsory. The researchers found that effective school environments, time devoted by students to academic activities, and students' understanding of the role they play in their own education positively contribute to higher than average levels of reading achievement. Most significantly the variables connected with schooling account for variance in reading achievement more than other variables, including family background. This suggests that effective schooling can prove beneficial for all students, regardless of other external variables.

To identify coping strategies among African-American students in urban settings, Steward et al. (1998) asked the 208 participants in their study to complete a self-reported psychological adaptation instrument and a coping inventory. The use of both instruments allowed the correlation of positive (and negative) psychological adjustment to the behaviors adolescents find most helpful to manage stressful and unfavorable situations. The Affects Balance Scale (ABS) is a 40-item assessment for self-reporting positive and negative emotions. Steward et al. calculated each participant's overall score on the test by averaging the presence of positive and negative affect. As the average score increased, so did the positive psychological adjustment of the subject. The

second instrument used in the study was the Adolescent Coping Orientation for Problem Experiences (A-COPE), a 95-item assessment used to identify adolescent coping behaviors. The behaviors were grouped to identify 12 different patterns of coping. Multiple regression analyses were used to reveal correlations between psychological adaptation, coping strategies, and academic achievement.

Steward et al. found strong correlations between positive psychological adjustment and the use of spiritual support and avoidance to manage difficult situations for students in the study. Those students also had the highest GPA. Students with the highest levels of psychological adjustment used family members for assistance with solving problems, had a sense of humor, and used relaxation activities to manage difficult situations. Overall, they described the urban adolescent experience as heterogeneous and successfully managed by employing a variety of coping strategies.

The literature implies that resilient students are able to mitigate unfavorable conditions and manage difficult situations. They are able to do so by participation in intervention programs and employing protective mechanisms and coping strategies. Resilient students possess both high levels of efficacy and healthy social identities. Their levels of efficacy drive them to persevere in academic situations while they are able to create strong support systems with their positive identities.

The students in the current study do not all come from what are considered urban settings within their state, but backgrounds notwithstanding,

they enter the same residential and academic environment at the residential school. Within the scope of the current study patterns of interest as identified by Steward et al. include: developing self-reliance and optimism; seeking spiritual support, investing in close friends; and seeking professional support. I expect that students employed more than one type of coping mechanism and may at times employed several. The highlighted coping strategies were thought to be the most influential in the lives of the study participants.

Correlation Between Identity and Academic Achievement as Factors Contributing to Resilience

The development of racial and social identity in conjunction with academic orientation, or lack thereof, has been examined by numerous scholars (J. V. Clark, 1999; Fordham, 1986; Hamm, 2000; Mehan, 1994; Mickelson, 1990; Moody, 2004; Ogbu, 1990; M. B. Spencer, Noll, E., Stolfzfus, J., & Harpalani, V., 2001). These scholars have disagreed about the attitude of achievement and duality of academic and social identities for minority students. Theories of oppositional identity and blocked opportunities have been critiqued and refuted with claims of healthy psychological development and positive racial identity. Literature suggests that the resilient African-American adolescent embraces a strong academic identity, possesses high levels of self-efficacy, and balances a bicultural identity (Floyd, 1996; Lee, 1991; Steward, 1996). This allows the student to succeed within the mainstream American educational system while preserving their African-American culture.

Students begin to be labeled and placed into academic tracks in middle grades based on ability and achievement levels. In mixed race educational environments, student stratification based on academic ability can lead to what may appear to be racial separation. In such an environment, some adolescents see academic achievement as adoption of Eurocentric values and may begin to reject education. Ogbu, independently and with Fordham, has founded theories about the poor academic performance of African-American children based on their belief that valuing education is “acting White” (1987, 1986). According to Ogbu, involuntary minorities, such as African-Americans, view the discrepancy between an ideology based on merit and hard work and the reality of blocked opportunities as the basis for the oppositional identity developed by African-American youth. However, Ogbu acknowledges that not all minority children fall into the category of oppositional and has identified the strategies that African-American students employ to negotiate between academic and cultural environments.

Ogbu lists the survival strategies of five types of African-Americans who to varying degrees grapple with the negotiation between their academic and social/racial identities. One extreme of the gamut of African-American negation exist the assimilators, who adopt mainstream values and disassociate with African-American culture. At the other end of the spectrum are ambivalent students, who have not mastered the negotiation, which results in negative ramifications for their individual existence in larger society. Those who fall in between include the emissaries, regulars, and alternators. The alternators are

able to successfully work between their academic and social environments, devaluing neither. They have what Rowley & Moore call a bicultural view (2002). Moody also suggests that African-Americans, by the nature of being African-American and in the United States, are bicultural (2004). The concept of biculturalism combined with the psychology of becoming Black supports the argument that those best able to incorporate values from the dominant society (academic achievement, standard English, etc.) into their own set of religious, moral, and political value systems are better adjusted and able to perform within American educational economic, and political systems. Many students believe in the ideology that stresses the importance of education, but are not always able to translate those abstract beliefs to their concrete attitudes about the benefits of education (Mickelson, 1990).

While acknowledging that African-Americans have lagged behind White in math performance (NAEP) and are underrepresented in gifted academic programs (Grantham, 2003), Ogbu's "Acting White" theory cannot be fully supported here as explanation for lagging scores or low representation. WHY? Neither can it be used to explain the existence of students who successfully maintain their cultural identity and high academic orientation (Mehan, 1994)WHY?. Referring to Cross' model of nigrescence, it appears that students who do not perform for fear of being labeled as "acting White" have not progressed to the internalization stages of nigrescence. Tatum's observations suggest immersion as the phase of development for African-American adolescents who have faced encounter and are progressing through racial

identity development (2003); in this phase, they reject mainstream American values in favor of more Afrocentric ones.

Other studies have demonstrated correlation between high academic achievement and racial identity for African-Americans (M. B. Spencer, Noll, E., Stolfzfus, J., & Harpalani, V., 2001). In addition, Mickelson found that most students, African-American and White have similar abstract attitudes about the importance and value of education (1991). However, the lived experiences of African-American students do not enable them to see the benefits of education occur as frequently as White students may. This does not discourage all minority students from achieving. Peer relationships and support networks make it possible for adolescents to maintain high academic orientation and friendships within their ethnic identity (J. V. Clark, 1999; Datnow, 1997; Mehan, 1994).

During immersion, students may separate themselves from Whites and the values of White American society, which can include the value of high academic achievement. In mixed racial environments, where White and African-Americans co-exist, there is a greater likelihood of rejecting education as a mainstream value. However, in segregated or majority minority academic environments, being smart and academic achievement do not separate African-American students from their peers. Because social identity – in its many dimensions – is situational-specific (Hamm, 2000; Sellers, 1998; M. B. Spencer, 1999), so may be the development of academic orientation.

Hamm (2000) and Wade & Okesola (2002) have investigated the significance of peer group influence for African-American adolescents and the

factors surrounding peer group selection. The desire to be more like their peers or included in a peer group can undoubtedly influence the amount of effort African-American students make in their academic pursuits. Tatum found that peer influence does not draw African-Americans to their peers, but does have an influence on their rejection of White peers and social groups. Students are more likely to be negatively influenced by their peers when they have not yet formulated a healthy, positive identity. However, students with healthy identities demonstrate higher levels of academic achievement (Chavous, 2003; Grantham, 2003).

Less well-adjusted students are impacted more by the influence of their peers and inclusion in a peer group (Tatum, 1997). One of Ogbu's studies found many students with prior records of academic achievement downplaying their intelligence, not participating in advanced courses, and offsetting their intelligence by emphasizing athletic and social popularity to remain in their peer group (1987). Labels of "brainiac" and allegations of homosexuality accompanied good grades in the student's peer groups. When forced to choose, a student's motivation orientation (internal vs. external) draws them to either the classroom or their peer group. External motivation (and identity) will result in peer group selection while internally motivated students choose the classroom. If indeed in the immersion/emersion stage of nigrescence, the identities of African-American adolescents are more externally defined; they have no desire to be ostracized by their peer group. They may even deemphasize the importance of education to maintain good social standing.

For students who place more emphasis on academic orientation than ethnic identity, support for academic pursuits may be solicited from outside their ethnic group (Wade, 2002). This does not directly translate to the centrality of race for African-American students emphasizing academic orientation. The centrality of race may vary among students who demonstrate psychological health and strong academic orientation (Chavous, 2003). The identification of coping strategies among African-Americans supports the concept of healthy psychological adjustment of African-American students with records of academic achievement (Steward, 1996). This and other work (Floyd, 1996; Lee, 1991) also support the ability of resilient African-Americans to successfully employ strategies for managing difficult situations and achieving goals in the face of adversity, whether the challenge is within the classroom, among peers, or in community conditions.

The challenge for most adolescents is progressing through the stages of racial identity without harming their academic achievements. African-American adolescents develop both social and racial identities, and not all progress at the same rate. However, students often seek out the acceptance for their actions and value systems by their peers. They also tend to develop peer groups based on the dimension of identity that is most important to them (Hamm, 2000). Without the influence of peer groups, "acting White" allegations would not be made toward Blacks who are gifted and achieve academically. There would be no risk of ostracism and exclusion from one's peer group if being smart were either readily accepted or not seen as adoption of Eurocentric values. When

students in racially diverse environments, mostly schools, begin to see the patterns of separation and exclusion based on achievement, they may create alliances based on similarities (Hamm, 2000; Wade, 2002) and begin to alienate those who have not had the same experiences as they (Tatum, 1997). The impact of peer group influence is greatly determined by the level of development in each adolescent. Resilient students often possess healthy identities and are not affected by the stigma of “acting White”; those more easily influenced by peers, in seeking acceptance, will make attempts to avoid accusations. As students progress through the stages of racial and social identity development, they will be better able to determine the dimension of identity that is most salient and make their academic and peer group selections accordingly. The more resilient students possess a stronger sense of control over situations than do less well-adjusted students, therefore becoming less a victim of circumstance, and more efficacious.

Literature on the combined formation of academic and racial identities is not abundant in specialized learning environments. African-American adolescents at specialized schools fall into two categories, high achieving and African-American. As African-American students are incorporated into the academic community at schools like Caldwell Academy, they are also developing a sense of racial identity that changes with age, personal experience and exposure. In general, students with positive racial identities are at an academic and social advantage. They achieve at higher rates than those with less

developed or negative identities (M. L. Clark, 1991) and they are better able to choose peer groups based on levels of comfort (Wade, 2002).

At Caldwell Academy, the specialized school in the current study, the African-American student population is significantly less than the desired reflection of state statistics. The students who have been admitted to the school as a result of their prior achievements in mathematics and science must begin to negotiate between being smart and African-American. While the strategy of negotiating between their home and academic environments is eliminated by living on the academic campus, the student must re-establish themselves academically while creating relationships with students and teachers.

The qualitative study here begins by using quantitative data to inform the researcher about course-taking trends among African-Americans at the school from 2000-2004. A quantitative racial identity assessment gives insight into the ideologies and attitudes about race possessed by the participants. Individual interviews and a focus group serve as the final qualitative portions of the study, painting portraits of the mathematically successful students in the study who do not enroll in the higher-level mathematics courses offered at the school. The results of the study provide administrators and faculty with information about the relationships between mathematics and racial identity for African-Americans, which is more salient with students, and hypotheses for encouraging the healthy co-existence of both.

As the number of state-supported and private specialized schools of mathematics, science, and technology continues to increase, the scenario

captured in this study will be repeated across the nation. The same sets of challenges faced by African-American students in this study are expected to be experienced by minority students at other specialized schools. Though each student's experience will be qualitatively different, common themes and scenarios are expected to resonate among the students. This study can potentially serve as the framework for uncovering challenges faced by African-American students and the development of mathematics and social identity in the midst of their residential experiences.

Chapter 3: Methodology

Theoretical Perspective

Phenomenology was chosen as the theoretical research perspective of the study to best capture the experiences of the participants.

Phenomenological studies deemphasize objectivity and focus on using the participants' words and perceptions to interpret their experiences (Glesne, 1999; Tesch, 1987). Based on the philosophical writings of Husserl, phenomenology allows the researcher to study in-depth the experiences of the individuals in the study, to capture their experiences, and to interpret the phenomenon through the lens of the participants (Creswell, 1998). The data and findings of a phenomenological study are largely subjective as reported by participants and interpreted by the researcher. The participants give their versions of their lived experiences and the researcher's interest and familiarity with the given phenomenon brings certain knowledge of the studied topic (Tesch, 1987). This study paints portraits of mathematically successful African-American students at Caldwell Academy, a specialized school. The students' mathematical experiences at their home schools and the specialized schools are conveyed to the researcher in their own words to capture the essence of their mathematics lives as African-American students with records of mathematics achievement.

The current study tells their stories by exploring the strategies they employ to create mathematics and social identity.

The main goal of the study was to determine what factors contributed to the lack of African-American enrollment in higher level mathematics courses at Caldwell Academy. To identify those factors, these research questions were posed:

1. How confident do African-American students feel about their ability to successfully complete mathematics courses?
2. What academic and social strategies do mathematically successful African-American students employ?
3. What type of shift occurs in the development of racial and social identity of African-American adolescents at a specialized, residential high school?

Mathematical success during the junior year at Caldwell Academy created more choice in senior mathematics course enrollment for students like the ones in the study who did not always take advantage of their increased options. This phenomenological study used the participants' accounts of their experiences to reveal the complexities behind the lack of enrollment in higher level mathematics courses that would not be uncovered by other investigative means or types of studies.

I was allowed to interpret the mathematics and social experiences of the participants through their own accounts through phenomenology. Understanding that the majority of phenomenological research is of significance to the researcher conducting a study (Tesch, 1987), it is acceptable to become involved

and invested in the research while searching for common threads to tie the experiences of the participants together. The commonalities of the students' experiences shed light on the lack of African-American enrollment in higher level mathematics courses.

Through the use of phenomenology, I was also allowed to determine how my own experiences shape my perceptions and interpretations of the participants' experiences. Having attended a similar school, the experiences of the study participants were expected to resemble those of my own. However, phenomenology dictated that I recognized the portions of their experiences that were inconsistent with mine, as well as those that were parallel. I was forced to contend with my own pre-conceived notions as a researcher – which were largely based on my experiences – and to use them to interpret the participants' stories when applicable.

School Context

The Caldwell Academy student population at the time of the study was slightly more than 600 students. The school tried to reflect the demographics of the state population in the student body. According to the 2000 US Census, 21.6% of the state population was African-American (<http://www.census.gov>, 2000). However, at the time of the study there were 71 African-Americans in the student body of approximately 600, with 20 African-American students in the senior class (six of whom agreed to participate). This 11.8% African-American

population statistic was comparable to national figures, but not to state demographics.

Students at Caldwell Academy were admitted from all across the state. Students attended their local high schools during their freshman and sophomore years, applying to Caldwell Academy during their sophomore years. The admissions process was based largely on academic records, but included teacher recommendations, Scholastic Aptitude Test (SAT) scores, extracurricular activities, and an essay in the admission process. Students were admitted as they compared to students in their state congressional districts.

Caldwell Academy operated on a trimester system as a method of offering the students more options for enrolling in electives. During the first trimester of their junior year, students enrolled in four core courses. Core courses for juniors are defined as mathematics courses, a combined English and US history course, foreign language courses, and science courses. Although students were able choose from biology, chemistry, and physics for their science courses, many junior students initially enrolled in biology. During the remaining trimesters of their junior year and their entire senior year, students enrolled in five core course with options for elective courses

The academic day was scheduled into seven 50-minute class periods. The schedule rotated, giving each class at least one day with a 90-minute class and lab block. Lab blocks were used to conduct hands-on experiments, collect data, or administer tests. The regular mathematics courses met four days each week, including one regular class bock combined with a lab block. The

mathematics courses with advanced topics, designed for talented mathematics students with intellectual insight, met five days a week including one lab block.

In addition to academic rigor, students committed themselves to many of the extracurricular and campus activities offered. The school offered conference athletics and a wide variety of clubs and organizations. Students participated in after-school activities ranging from chess and mathematics clubs to Asian Cultures, drama, and a junior chapter of the National Society of Black Engineers.

Students lived in residential halls during the academic year. The majority of students lived in double rooms. Students had the option of requesting a roommate, which was honored when the request was mutual. Otherwise, students were randomly assigned to rooms. By entering a lottery, senior students who desired to live in the school's few single rooms were chosen. Approximately every six weeks, the students were sent home for an extended weekend break. As high school students, they were minors living away from home and extended weekends were scheduled to mitigate feelings of homesickness.

The administration at Caldwell Academy worked with the state legislature to create a tuition grant. The grant stipulated that students who successfully graduated from Caldwell Academy and were accepted to any of the state's public post-secondary institutions would receive \$3000 toward their tuition. The goal was to entice Caldwell Academy graduates, considered many of the state's best students, to remain in their home state. One unintended consequence of the grant was a significant increase in applications for admission. The increased

application figures resulted in the admission of approximately 20 African-American students, less than 10% of the students admitted that year. The students who were approached for participation in the current study were part of that admitted class.

The larger context of this study was investigating the lack of enrollment in higher-level mathematics courses by African-American students at Caldwell Academy. The mathematics course enrollment histories of African-American students graduating from 2000-2004 was used as a sample to identify any trend among the student population. Enrollment data from the years of analysis are in Table 1.

Mathematics Course Enrollment Histories: Classes 2000-2004

Graduating Year	African-American Student Population	Eligible	Taking Multiple Math	Taking Advanced Courses
2000	28	11	4	1
2001	36	12	3	2
2002	31	13	3	3
2003	39	11	6	0
2004	32	11	2	2

Table 1: Mathematics Course Enrollment Histories of African-American Students

During the years of analysis, the African-American population ranged from 28 – 39 students. Proportional state representation would be approximately 120 students each academic year. Students who withdrew prior to graduation were not included in the reported population or analysis. Of the average 11 students per year eligible to enroll in higher level mathematics courses no more than three students would do so in any given academic year. At least two, but no more than six students from each class enrolled in two mathematics courses each

grading period, most often simultaneously enrolling in Statistics and Calculus. One student in the graduating class of 2002 was simultaneously enrolled in an advanced mathematics course and another mathematics course. This student was the only one to do so during the years of analysis. Other students in higher level mathematics courses were enrolled in one mathematics course per grading period.

According to the NCTM *Principles and Standards for School Mathematics* (2000), mathematics instructors at Caldwell Academy worked to create classroom environments fostering learning and understanding among all students. Despite their efforts, eligible African-American students were not choosing higher level mathematic courses. This implies a discrepancy that is discussed in Chapter 5.

Participants

Because the larger goal of the study was to uncover the reasons underlying lack of African-American enrollment in advanced mathematics courses at Caldwell Academy, the participants in the study were identified as those who most likely would have the option to enroll. The participants were selected from African-American seniors in the student body at the time of the study. Criterion sampling was used to identify students enrolled in Precalculus during their junior year who earned a course grade of B- or higher; students entering the school in courses higher than Precalculus were also identified as potential study participants. All junior students at Caldwell Academy were

enrolled in mathematics courses based on their score on placement tests administered during the application process. Seniors meeting the criteria had more flexibility to choose from the variety of advanced mathematics courses and mathematics electives during their senior year. Students with a course-ending grade of C+ or lower in Precalculus during their junior year had a smaller number of courses from which to choose.

Senior students were enrolled at Caldwell Academy for one year and able to articulate the similarities and differences between their academic and social environments at Caldwell Academy and their homes. By their senior year, students become acclimated to the living-and-learning environment required by attendance at Caldwell Academy, as well as different strategies employed for academic success and social survival. After a year at the school, seniors were expected to have a fuller sense of their experiences and are to offer reflective anecdotes conveying their experiences inside and outside the classroom.

Procedures

Fourteen students were identified by criteria sampling as eligible to participate in the study. Minor studnets were contacted after their parent(s) consented to their participation in the study and student assent was requested of those students. Students of age at the time of the study were approached directly for participation. The parental consent, student assent, and adult assent forms are in Appendices A, B, and C, respectively. After consent and/or assent forms were obtained from each student, the data collection process began. Six

of the eligible students, two male and four female, agreed to serve as study participants. Data collection procedures for this qualitative study included existing school data, mathematics autobiographies written by the participants, a racial identity assessment, qualitative interviews, and a focus group.

Data Collection

Existing data collected by Caldwell Academy for students graduating between 2000 and 2004 were analyzed to identify trends in course-taking among African-American students, as reported in the previous section. Data were presented earlier, and trends will be revisited in Chapter 5 as they relate to the students in the current study.

The requested mathematics autobiographies provided information about the participants' previous and current perceptions of their ability to be successful in mathematics in their own words. Students were asked to write about their mathematical experiences both inside and outside the classroom during their entire academic careers. They were also asked to describe both positive and negative feelings about mathematics and what sparked those feelings. The autobiography took no more than one hour for each student to complete. The autobiography protocol is attached in Appendix D.

Once the autobiographies were completed, the participants were asked to complete a racial identity assessment. The Multidimensional Inventory of Black Identity (MIBI) is a 56-item racial assessment containing items pertaining to the centrality, ideology, and public and private regard, all dimensions contributing to the racial identity of African-Americans (Sellers, 1998). This quantitative

assessment was used in a qualitative sense to inform the researcher about each participant's sense of racial identity. The racial identity assessment took approximately 30 minutes to complete. A copy of the MIBI can be found in Appendix E.

Qualitative interviews were conducted individually with each participant to unveil the details of the African-American experience that could not be quantified. A standard interview protocol was used, but the autobiographies and assessment responses were used to identify other questions and areas of interest. Therefore, the questions used in each interview potentially varied with each study participant. The interviews were used to enhance the autobiographies and provide information about the participants' academic identity as it pertained to mathematics and the formation of their social identities within the specialized environment of this residential high school. These interviews addressed mathematics orientation, peer group selection, and general African-American experience at the school. The interview protocol is attached in Appendix F.

Each interview took approximately one hour. All participant interviews were audio-taped and transcribed at the completion of each interview. To encourage participants to respond honestly, the confidentiality of each participant was promised during the study, as outlined in the consent/assent forms.

As a last data collection method, a one-hour focus group was conducted to expand on common themes that were identified from the individual interviews. Students were able to relate to the others students' experiences that were shared during the focus group, thus enhancing the collective portrait of the study

participants. Sharing experiences with their friends that were likely not discussed openly gave the students an opportunity to share, and make sense of common experiences both before and after enrollment at the school.

Data Analysis

The data analysis was ongoing as the data was collected to drive the next collection method. Quantitative data was used to enhance the qualitative portions of the study, due to the small size of the sample. Qualitative data from the interviews and focus group were transcribed by the researcher, coded and analyzed. The analysis includes an extensive process to identify emerging themes that are common to the participants' mathematics and social experiences. Themes from the transcribed data were identified using Van Manen's "highlighting" approach, referred to by Tesch (1987). Through this method, descriptive expressions central to the mathematical successes of African-American students were recorded and used as "gems" to convey the essence of the phenomenon to the reader.

The participants were asked to complete mathematics autobiographies, supplementing their mathematics course history with qualitative experiences. Several themes emerged from the experiences of the participants. The lone piece of quantitative data for the study was the racial identity assessment (MIBI). The MIBI used to determine how each student felt about his/her racial identity, in what regard each student held race, and the type of ideology most highly demonstrated by each individual. Responses to the MIBI could not be used to predict reactions and situational behavior, but were used in the larger study to

interpret participant responses to interview and focus group questions. The MIBI enhanced the portion of the interview regarding social identity and with whom the students feel more comfortable in academic and social settings. Interpretations of their responses were derived from the categories provided in Chapter 2.

To find themes among the experiences of the students, the data were analyzed using a nonlinear approach to permit investigation using data management to group recurring terms and experiences. Atlas TI was used to create documents for searching and creating coding systems. Use of such software facilitated data management and coding. From the highlighting system mentioned above and software, themes emerged from the collected data. The common themes among participants and others items of interest are shared in the following chapter.

Chapter 4: Portraits and Findings

The following chapter, an analysis of the collected data has a twofold purpose: 1) to provide (descriptive) portraits of the students in the study; and 2) to elaborate on the portraits through analytical findings based on the identification of common themes in the data. The first section, descriptive portraits of each student, is created using their own words from mathematical autobiographies, and the individual interviews. Each student's portrait begins with an excerpt from their autobiography, and thus, is written in the first person. My interpretation of the details from the individual interviews were used to complete each student's individual portrait.

The second section of the chapter presents research findings as a result of the data collection. The descriptive statistics from the MIBI and focus group responses were used as the primary basis for the findings. This section also presents common themes and directly addresses the research questions. I was able to identify common themes from the student portraits and their focus group participation. Those themes were interpreted within the larger context of mathematics course-taking among African-American students at Caldwell Academy. Two major themes emerged from the common threads in the students' stories: 1) mathematics self-efficacy; and 2) support systems. The analysis of the student data defines and explores each of these individual themes

and discusses each as it relates to a larger theme among all the participants: resiliency. To maintain confidentiality, pseudonyms have been used in the study in lieu of the actual names of people and places involved.

Portraits

Patricia

I would have to say I was drawn to mathematics at a very early age. My father was an electrical engineer so he was a big promoter when it came to math. Before I had even begun elementary school, he would try to teach me basic mathematical skills. Then once I started elementary school, he would give me extra homework by giving me more practice problems on whatever topic we were covering in my actual math class. Even though I was at first very reluctant to do this extra homework, I eventually enjoyed the practice because it made me perform better in the classroom.

My father would also make me prepare for my math class during the summer time; for example, when I finished fifth grade, I had to work daily out of a sixth grade math workbook. However, when middle school started for me, my father became less involved in my schoolwork and gave me more independence academically. Despite this, my work ethic did not slacken in the least. It was then early in my middle school career that I realized that I was “good at math.” I discovered my natural ability by finding myself solving problems quicker and more accurately than the majority of the class. The other students helped me to realize my ability through their tendency to seek me out for help. I remember feeling so good when I knew I had truly increased someone’s understanding of math.

Patricia was from one of the larger cities in the state. Her hometown had a population of 200,000 and was located in a central region of the state. Her parents were college educated and she lived in a two-parent home. As is evidenced from her mathematics autobiography, her father was instrumental in her mathematics development.

Patricia defined a good mathematics student as one who possessed dedication, good work ethics, and the desire to be challenged. She believed that there are two different ways for students to be mathematically successful: through natural ability or work ethic. She attributed her success to work ethic and said she made good grades, but “could probably do more practice.” Patricia believed that with practice, one could be “good” at mathematics. The repetitive nature of mathematics appealed to her. When asked if both methods – natural ability or strong work ethic – could result in the same mathematical accomplishments, Patricia thought it was possible.

Patricia described her mathematics experiences at her home school in relation to how much she liked her teacher. She liked her teacher freshman year, but did not feel the same about her sophomore year mathematics teacher. In that particular class, the students worked in pods which promoted group work, but Patricia felt that teacher had to spend a majority of the class disciplining students. Thus, the amount of work that was accomplished in class was inhibited; and because the class was required to reach a certain point in the curriculum, the students had to compensate for the unfinished work by completing more homework.

At Patricia’s home school, studying consisted of reviewing notes and reviewing old quizzes. Because of the large amount of homework that was assigned in her Integrated Mathematics Course, she spent about 45 minutes each evening completing homework. Patricia felt she was an above average mathematics student at her home high school. She rated her mathematics

performance as 8 out of 10 at home, while rating her effort at a 5. Patricia earned A's in Integrated Mathematics 2 and Integrated Mathematics 3, which she took during 9th and 10th grades, respectively.

Prior to attending Caldwell Academy Patricia's social circle during school was pretty much the same as her circle after school: diverse. She shared the same type of ambition, goals, and interests with the people who were in her social circles. Patricia's parents were from Jamaica and had formerly lived in California, where she perceived racial diversity as not uncommon. Patricia did not describe her school experiences in terms of race, but recognized that she has the ability to transcend different circles based on her general acceptance of all types of people.

Patricia was the only study participant concurrently enrolled in two mathematics courses, Calculus and Statistics. At Caldwell Academy, Patricia discovered how mathematics could be applied to real life and could "see why you could use it in any career that you would go into." She found that especially true of Statistics, but not of Calculus. Statistics was relevant to her post-secondary interests in psychology, but Calculus presented challenges to her academic career. Patricia was initially enrolled in the topics section of Calculus; she earned an A in Precalculus. Calculus with advanced topics became the mathematics class in which she earned her first C. After enrolling in a general section of Calculus during the next two grading periods, she again earned A's.

During her junior year, Patricia attended department tutorials more frequently than during her senior year. Patricia believed that mathematics

performance depended on “how much effort you put into it.” She defined studying as simply completing her assigned homework and seeking assistance if she had trouble. Patricia mentioned that she tried to do extra practice problems when studying. In her mathematics classes, there was generally some type of assignment every night, on which Patricia spent about 45 minutes.

Patricia described her overall experience at Caldwell Academy in terms of the relationships she established with her peers. She expressed slight difficulty in living in a residential environment where all activities seemed to occur “in a bubble.” The intimate nature of the small school population made her feel as though everyone was aware of the social and academic activities of others.

Jená

I have always had pretty positive experiences with mathematics. For as long as I can remember, math has always been one of my favorite and best subjects. It wasn't until I came to Caldwell Academy, that I realized that I wasn't as good in math as I thought. Eleventh grade was the first time I actually struggled in math, and for the past two years, I have been struggling to maintain a good average in math class at Caldwell Academy.

I first realized I was good at math in the 2nd grade. It was in the 2nd grade that I initially got placed in advanced classes. I remember feeling special being placed in the “smart” class. I used to enjoy leaving my normal class to go to the more special classes. I suppose my teacher helped me realize I was good at math. When I first realized this, I felt very smart and special. I remember at this young of an age though, still feeling like a regular kid. You didn't feel smarter than people or anything because you were still treated the same as everyone else.

Jená did not like mathematics; she was just “good at it.” She did not see the usefulness of mathematics or how it fit in to her life. There were no specific

dislikes; just that she did not see its applicability to her future academic and career plans. Her desire to major in psychology or business did not necessitate mathematical strength in her opinion. She did mention, however, that being good at mathematics made her feel smart, and she liked that.

Jená described a good mathematics student as being someone who continued to work on a problem to figure it out and did not just give up at the beginning. She referred to being able to reference prior knowledge to apply to current problems because mathematics was cumulative and a student may have to know many things to solve a problem. Jená thought that enjoying mathematics was required to be a successful in mathematics, because “the more you enjoy it, the more you continue to work with it.”

Jená applied to and enrolled at Caldwell Academy to get away from her home high school. Jená was from a relatively small county in the state. Her township was too small to be represented in the state census. She also wanted to benefit from the tuition grant allocated by the state for Caldwell Academy graduates who attended post-secondary institutions in the State University system.

Jená thought that she was just as smart as before attending Caldwell Academy, but she admittedly struggled in mathematics. Through repetition, she was able to perform well in mathematics at her home school, but could not use the same strategies at Caldwell Academy. The A's she had previously earned in Honors Geometry, Honors Algebra II, and Advanced Mathematics at her home school were met with B's in Precalculus and Calculus at Caldwell Academy.

Jená did not think that she was as good at mathematics after enrolling at Caldwell Academy. She thought she was still smart and gifted, but mathematics at Caldwell Academy was extremely hard because “it [was] not simple Algebra anymore. It [was] Calculus and that kind of stuff” which required her to study; she did not dedicate much time to studying mathematics at her home school. At Caldwell Academy Jená studied about an hour and 45 minutes each night for mathematics, which she described as doing her homework and looking at her notes if she needed assistance. She believed that a part of being successful in mathematics was the ability to quickly remember necessary concepts and skills; she admittedly did not have the patience to persevere when problems became difficult. If she did not understand a particular mathematics concept by the time of the study, she felt as though not going to know it. Jená saw no point in mentally over-exerting herself if a mathematics problem proved difficult and was not immediately solved.

Jená had two different circles at her home school: mostly White students with whom she attended classes and the African-American students with whom she spent time socially outside of class and on the weekends. At Caldwell Academy where she attended classes and lived, Jená described her social circle and peer group as completely African-American. Her social circle consisted mainly of students who attended church with her. Jená was studying to be a youth minister, and her peer selection reinforced the importance of spirituality in her life. She and her close circle of friends had church in common, but she felt

as though their different personalities and characteristics complemented each other.

Jená described her overall experience at Caldwell Academy as typical of most students, as far as mathematics was concerned. She went from thinking she was really good at mathematics to thinking she was not good at all. Jená's statements created a contradiction. At one point during the individual interview, she stated she was not good at mathematics, but later said she felt as though she was still smart and could perform better in mathematics if she put forth more effort.

Lewis

I was first drawn to mathematics in about the 7th grade. This is the time when I was placed in an advanced mathematics course known as Pre-Algebra. The fact that I was chosen for this advanced course, prompted me to perform well and stand out among my peers in mathematics.

I first realized that I was "good at math" in about the 4th grade. At this time, I noticed that I would receive better grades on my mathematics assignments than my peers would. I also noticed that I would assist my peers with their mathematics assignment and while they were having trouble grasping certain concepts, I seemed to understand the material very well. At this young age, I didn't really think it was a big deal because I did not understand the consequences of being "good in math". However, I did feel good about myself performing better than my fellow peers.

Lewis liked the objectivity of mathematics; there was usually a concrete answer or concrete method in mathematics. While he enjoyed the hands-on calculations that were part of mathematical activities at Caldwell Academy, he disliked the tedious and time-consuming nature of mathematics.

Lewis described a good mathematics student as someone who would practice daily because daily practice assisted students in learning multiple problem-solving solutions and certain topics. By his definition, being a good mathematics student required students to spend time on mathematics after each lecture, reviewing notes, and working on practice problems. Part of being a good student for Lewis was asking questions to make sure the student understood concepts completely. To Lewis, being good in mathematics was making good grades, which he felt he did throughout high school. Lewis earned A's at his home high school in Honors Geometry and Honors Algebra II. At Caldwell Academy his grades were the same, with the exception of a B during the third trimester of Calculus. Lewis called his ability to apply ideas from mathematics lectures to homework and tests, learning efficiently.

Lewis applied to and enrolled at Caldwell Academy because he felt there were more opportunities available there than at his home school. He was not only referring to academic opportunities, but the chance to meet different types of people and to participate in different research and summer programs. From a small town in the state, Lewis did not foresee having the same opportunities for excellence at home. His hometown was in the eastern portion of the state, with a population of about 5000 people.

Lewis explained a difference between doing homework daily and studying daily. According to him, studying consisted of carefully and tediously reviewing notes and working extra problems and sample problems. Doing homework on a daily basis was simply completing assigned problems, "getting them out of the

way”, and closing the text. Lewis felt he was a good mathematics student, but he could have been better by studying more. He reported completing homework each weeknight for about 45 minutes each night.

For Lewis, mathematics performance was related more to one’s motivation and interest than one’s actual ability. He felt that those who were interested in mathematics were motivated to do mathematics. Those who were not motivated to do well would not do anything despite their ability.

Like other students in the study, Lewis had two social circles at home: a school circle and an after school circle. Lewis’ primary social circle at Caldwell Academy was what he called the “Black crowd”. He felt as though the African-American students at Caldwell Academy combined the best qualities of his two social circles at his home school. The students at Caldwell Academy were all smart so he socialized with African-American students, with whom he felt most comfortable, and knew that they are motivated to do something in life. As African-American students, they were “down to earth and [could] relate to a lot of things” (the African-American experience), but they possessed what Lewis called “self-development.” The students in his social circle had many academic goals and aspirations which he shared. He also felt able to relate to them outside of the classroom because of similar racial backgrounds. Having African-American students as his social circle was important to Lewis. He believed that African-American people shared a common interest and a common goal. Those things, in addition to a common history, made Lewis feel whole when he was around other African-Americans.

Lewis described his experience as being different from most students' experience due to factors such as socioeconomic status and race. Socioeconomic status (SES) played a large part in Lewis' experience because of the hidden costs of attending Caldwell Academy. There was no cost for attendance, but Lewis perceived students with more money as those who were able to attend events and have nicer things. He did not cite his lower economic status as a disadvantage, but simply an instance in which students with less money had to "work harder to get something that someone [else had] handed to them on a daily basis." Race contributed to Lewis' experience at Caldwell Academy as a result of perceived discrimination and lowered expectations. He thought some people at the school were racist and would look at him expecting failure or lack of ability. He also realized there was no way to prove his suspicions of racism, so he continued to work to the best of his ability.

Tyrone

I was first drawn to mathematics during the fourth grade when I was put in the AG (academically gifted) math class. I was very proud to hang out with the rich kids at my school as they were all in the AG class. While I was in it, I excelled in math and they came to me for help, this made me want to do math even more because even the rich kids liked me. I was drawn toward it because mathematics is the one thing that is concrete. There is little interpretation in the calculations are far as their meaning. Unlike in English and history where you have to infer meaning to phrases that have more than one interpretation. Also, in math, everything is foundational. What I mean is that one thing leads to another, you can't do Calculus without Algebra and Geometry nor can you do algebra without basic math skills.

It wasn't [un]til 4th grade that I realized I was good at math. This was when I was the only person with an A in the AG math

class. After this, my peers came to me for math help and they would tell me “Tyrone you’re so good at math”. After a while I accepted this as fact. My peers helped me to realize that I was good at math. Once they realized that I was good, they told me also. My parents weren’t too aware other than the grades that I’d receive, yet even they didn’t point it out at the time.

Tyrone liked mathematics because there was no gray area. To him, there was little interpretation in what numeric solutions meant. He expressed greater appreciation for mathematics and science than humanities because of their objectivity. “There is always one answer [in Calculus].” A good mathematics student possessed mathematics literacy and creativity by Tyrone’s definition. Persistence and referencing both concepts and ways of solving different equations are characteristics that Tyrone cites in profile of a good mathematics student.

Tyrone chose to apply to and enroll at Caldwell Academy to have what he described as an “open setting.” He thought living away from home was interesting and something he wanted to experience. Tyrone was also strong in science and mathematics, which are the focus of the school. In describing his feelings about his mathematical abilities since enrollment, he wrote:

I feel the same way about my abilities now. My first (junior) year at Caldwell Academy caused me to doubt myself and my abilities in math. However this year, my perspective changed and I realized that no one can take those abilities from me and that no one had taken those from me. Therefore, I accepted that I was still good at math.

In contrast to his home school, Tyrone had to put a lot of thought into mathematics at Caldwell Academy. He was no longer able to memorize equations, but he had to understand where each equation originated, creating

what he called “the annoyance of what’s behind math and why it is true.” Though annoyed, Tyrone felt his mathematics classes at Caldwell Academy prepared him to speak intelligently about mathematics instead of simply supplying numeric answers with no underlying understanding of meaning and application. Tyrone’s grades at Caldwell Academy reflected his preparation. He had earned A’s in Honors Geometry and Honors Algebra II at his home school. At Caldwell Academy he earned A-’s in Precalculus and Calculus, with the exception of a B in the third grading period of Calculus.

Tyrone’s peer circle shifted from a mixed White and African-American group at his home school to completely African-American at Caldwell Academy. The students in his small circle attended the same church he did and possessed similar personalities. His social circle at Caldwell Academy was less diverse than at his home school. Tyrone was able to socially spend more time with African-Americans at Caldwell Academy because they had goals; he felt as though the majority of African-American students at his home school lacked goals and ambition, so he chose to not associate with them.

Tyrone felt there were certain preconceived notions that students had because he was an African-American male. His non-African-American peers seemed to make an extra effort to assist him, assuming he did not understand material. His first impression was that they were being very helpful, but he realized that it was a consistent underestimation. Tyrone did not seem to receive the same treatment from teachers, but he constantly worked to change the perceptions of others by his own standards.

Jackie

I was first drawn to mathematics in 3rd Grade when we were learning to add and subtract, my mom purchased a computer game that taught math. I liked playing the game/ learning math because when I would get questions correct the program made a little smiley face. This program had many levels and soon put me ahead of my class. I was drawn to mathematics because I liked impressing people who would ask me questions. I liked to learn anything when I was younger, math was an easier thing to learn because I soon realized that there formulas and tricks. I never considered myself a “math person” but I knew I was good at it. I liked the cut and dry, right/wrong angle to math.

I remember being put in a 6th grade math class when I was in 5th grade at my private school. I did better than many of the 6th graders. We had timed multiplication quizzes that tested how fast we could think...the other 5th graders and I often finished faster and with more accuracy. However, there were other kids doing just as well as I was .When I transferred to public school for middle school I knew I was “good at math” when I tested into an advanced class. I would finish my work in half the period and sleep for the rest, and still make better grades. I didn’t feel challenged. When I made this realization I felt different. My classmates picked on me for being smart. I had plenty of friends, but I was different.

My mom helped me realize I was good at math. My teachers always seemed surprised.

Jackie was from the one of the larger cities in the state and lived in a single-parent home. Jackie’s mother graduated from one of the state’s most prestigious private institutions and possessed an advanced degree.

Jackie was one of the few African-American students enrolled in higher-level mathematics courses. She initially placed into Precalculus, but requested to be tested again because she had taken Honors Precalculus at her home school. Jackie took Calculus during her junior year and was the only African-

American student in Multivariable Calculus during her senior year. She also enrolled in Mathematical Modeling, another higher level mathematics course. Like all students in the study, she enrolled in more than the minimum five required trimesters of mathematics. However, she was enrolled in one mathematics course each of the six grading periods; she did not concurrently enroll in more than one mathematics course.

Jackie enrolled at Caldwell Academy for the academic experience and challenges. She spoke of balanced academic, athletic, and social activities at her home school, which were not quite matched to her satisfaction at Caldwell Academy. To Jackie, the typical Caldwell Academy student was more focused on academic than social endeavors; Jackie was interested in more than academics. Jackie measured true success not solely by grades, but by other activities that created a more well-rounded individual. She embraced a mentality defining being successful as being able to do well academically and participate in other activities, such as sports, research, or any other activities that are not academic. Jackie had a strong academic record, played sports, participated in research, and held a leadership position at the school. She did not understand how students who were not participating in time-consuming activities did not do well academically. Jackie thought everyone should be able to find something they can do outside of school so that school was not their whole life; that mentality drove her to find activities outside of class.

Jackie did not think her academic experience was affected by being African-American so much as her social experience. She believed she would

have dated more had she been White. Interacting with African-American males was difficult for her because it was expected by other African-Americans at Caldwell Academy that she only interact with the African-American community. Having a social circle that reflected her interests and not race was most important to Jackie. Socializing only with other African-Americans was not her preference.

Academically, Jackie thought that “people can have the best chance of not being discriminated against and to really go as far as they can.” She thought students could pursue different types of academic interest and stretch themselves academically. For that reason, she described Caldwell Academy as “the place to take advantage of everything here.”

Kyra

When I was in kindergarten my teacher made a comment that boys were better at math than girls, and from that point on in class I tried to prove to her I was the best math student in our class. I was pulled out for an accelerated math class starting in the fourth grade. I always enjoyed math in elementary school and I was one of the better math students in my grade. I don't have any negative memories, other than teachers not wanting to incorporate me in the accelerated math programs even when I scored in the 99th percentile on my EOGs in math. I was first drawn to math probably as a toddler or sometime before I went to elementary school. I was drawn to mathematics by laying with interactive games as a child, on the computer and hands-on- games. I also had a sense of competition and wanted to be right, [I] liked winning games.

I just remember being part of a select group of kids that left the class for math and English during elementary school. I don't really think I ever doubted I was “good at math” I just knew I liked it. It was not really surprising when I made this realization. I had not had any challenges yet, and math came naturally. All of my teachers, especially my 3rd grade teachers helped me realize it.

Kyra enjoyed the logical nature of mathematics. She believed once a student was able to solve a problem, the solution did not change; and once a student knew which [conceptual] tools to use he or she could solve a problem. She thought mathematics was common sense.

Kyra described her experience at her home school as mostly positive. She did not let other people define who she was. Her parents – Kyra’s mother was a doctor— told her that her identity was not constrained to being part of a certain group; she thought that played a big role in her academic success. Academically, Kyra did not think of herself as a girl, or an African-American. She thought of herself as a student first and went to class determined not to be the “best Black kid” in her class; she could be the best student. Sometimes her teachers would try to put her into a category, but they would not hinder her doing her best. By sticking to that attitude, she maintained a positive experience.

Attending Caldwell Academy was attractive to Kyra because she felt she was not being challenged at her home school. She was from a town in the state with an approximate population of 8,100. According to her, “the classes were pretty easy, and I was getting A’s without doing any work.” Kyra earned A’s in Honors Geometry and Honors Algebra II at her home school. Once at Caldwell Academy she had to adjust to working hard and not being the best student. Kyra admitted to learning how to talk with people to tell them her problems. She described the Precalculus course she was in during her junior year as “a little bit of a challenge,” but she was able to be good at mathematics if she worked hard.

She enjoyed her teacher and would frequently visit her outside of class. As a senior, being in Calculus was “frustrating” for Kyra because she was not able to understand concepts she was not able to visualize. In Calculus, she had to study all the time and felt her performance was more a result of her work ethic, not her ability. At Caldwell Academy, her work ethic generated an A- in Precalculus and Bs in Calculus.

Through her overall experience was positive, some of Kyra’s experiences made her want to prove to others that she was capable of doing certain things and be successful. Kyra described herself as stubborn and determined to accomplish goals she set for herself regardless of what others thought; that mentality helped her achieve her goals. Because of early childhood experiences when she was expected to be less successful in mathematics, she worked hard to be better than other students. She felt as though she had to prove herself initially at Caldwell Academy to be considered a good student. Kyra felt as though her junior teachers did not believe she was a good student until she began making good grades and was nominated for different awards. Kyra was chosen for one of the most prestigious awards at the second largest institution in the State University system.

Findings

This section of the chapter presents descriptive statistics from the MIBI responses and common themes from the research. The findings also directly address the research questions from Chapter 1. The MIBI subscale scores are

first presented in tabular form and described in detail. The common themes emerged as recurring protective mechanisms and coping strategies were mentioned during the data collection process, primarily individual interviews and the focus group.

MIBI Interpretations

Each participant in the study completed the MIBI racial identity assessment. The instrument contained 56 items, each on a 7-point Likert scale. The creators of the instrument separated the items to address each of the three stable dimensions of racial identity – centrality, regard, and ideology – and created subscales for each of the item groups. For each subscale, the lowest possible score was 1, while the highest was 7. Table 2 presents the subscale scores for each of the participants along with the average for the group.

	Patricia	Jena	Lewis	Tyrone	Jackie	Kyra	Avg
Centrality	5.00	4.86	6.71	4.71	5.43	4.57	5.21
Private Regard	6.67	6.17	6.67	5.00	6.50	6.67	6.28
Public Regard	4.33	3.33	1.83	3.17	2.50	3.00	3.03
Assimilation	6.11	4.89	4.89	5.44	6.11	6.00	5.57
Humanist	5.44	5.11	4.78	5.63	5.89	6.22	5.51
Oppressed Minority	5.11	4.11	4.89	4.56	5.78	5.22	4.94
Nationalist	3.33	3.56	5.56	3.89	3.89	3.56	3.96

Table 2: MIBI Descriptive Statistics

Patricia’s responses to the MIBI items associated with centrality suggested race was central to her identity. However, it did not prohibit her from establishing relationships with others, as was evidenced by the description of her social circle at Caldwell Academy. Patricia demonstrated a high level of private

regard and her public regard – what she thinks others think about African-Americans – was above the group average from the completed MIBI assessments. Of the participants in the study, Patricia had the highest assimilationist ideology, suggesting that she identified herself by finding commonalities among all Americans.

Race was not central to Jená's identity, although she stated in her interview that she felt more comfortable with African-American students and African-American teachers at Caldwell Academy. Her MIBI scores translated into high private regard, while her public regard subscale average was fairly low. Jená personally thought highly of African-Americans, but did not think that others had a positive image of African-Americans. In terms of ideology, Jená had the highest score among study participants on the humanist scale. She found commonalities among all humans; she viewed people as individuals, probably as a result of her strong religious connections and philosophy.

Of all the participants in the study, race was most central to Lewis. He demonstrated the highest private regard, but lowest public regard subscale scores on the MIBI. This suggested that Lewis personally thought highly of African-Americans, but believed others thought poorly of African-Americans. His ideology was nationalist; his focus was on the self-sufficiency and unity of all African-Americans.

Race was not as central to Tyrone's identity as to others in the study. His private regard did not suggest a high personal opinion of African-Americans, nor did he believe others thought highly of African-

Americans. His ideology subscale score demonstrated a humanist ideology more than any other. Based on a humanist ideology, Tyrone viewed all people as individuals, found commonalities among all humans and was less likely to define people in terms of race.

Race was relatively central to Jackie's identity. She thought fairly highly of African-Americans, but did not think that others thought highly of African-Americans. Jackie's ideology rated highest on the assimilation scale. The assimilationist ideology found commonalities among all Americans and focuses on working within the mainstream American structures to achieve goals. Jackie was most likely to work within the system to attempt to change it.

Race was the least central to Kyra's identity. She held African-Americans in high private regard, but did not believe others do, as was evidenced by her low public regard. She rated highest on the assimilation scale, implying that she found commonalities among all human beings. Kyra did not define people in regards to race; aligning with her desire to be viewed as a student, an individual.

The participants in the study had a wide range of responses to the items in the MIBI assessment. Each student was considered mathematically successful, but the components of their racial identities varied.

The previously presented blended theories of African-American academic self-efficacy and the linked social and racial identity of African-Americans in middle adolescence are used in the current study as the foundation for a theoretical framework of academic and personal resilience. To appropriately

address the larger context of mathematics course enrollment history among African-American students, it is necessary to explore the common themes that emerged from the individual interviews and the one-hour focus group. All six of the study participants conducted interviews, but only four (Patricia, Lewis, Tyrone, and Kyra) were available for the focus group. The themes evolved from the students' words and experiences as they relate to resilience. For the students in the study, resilience appeared to be the result of two protective mechanisms that emerged as recurring themes: 1) mathematics self-efficacy; and 2) social support systems.

Mathematics self-efficacy addresses each student's self-perceived ability to be successful in mathematics. This was determined by asking the students to share perceptions of their own mathematics ability both before and after attending Caldwell Academy. Students were also asked to comment on the likelihood of taking and passing certain mathematics courses that are considered higher-level at the school. Students directly and indirectly discussed their support through responses to interview and focus group questions. Social support systems for the students were created from peer groups at Caldwell Academy, established connections in their home communities, and occasional connections to others in the community surrounding the school.

Mathematics Performance and Efficacy

The students in this study were all eligible to enroll in the higher-level mathematics classes offered at Caldwell Academy, but many had failed to do so.

The self-reported efficacy of the participants did not decrease upon enrollment. This suggests that other factors contributed to their mathematics course enrollment decisions.

All of the students in the study stated that they put in more effort at Caldwell Academy than at their home school, but that their resulting academic performance was lower than at home. Jená shared during her interview that the difficulty she faced was a result of the increased academic rigor of mathematics at Caldwell Academy. Mathematics at Caldwell Academy was not “simple algebra anymore. It [was] Calculus and that kind of stuff.” No longer able to “pull stuff out of [her] head”, she had to study while her home school she did not have to study for mathematics. Jená was accustomed to rote learning and procedural understanding. Like Jená, Tyrone and Kyra shared during their interviews that they were accustomed to “learning” mathematics through example and repetitive procedures. They were accustomed to seeing a mathematics topic introduced in class through example and having the same type of problem presented in homework assignments and on assessments.

Mathematics courses at Caldwell Academy were not taught in the same manner as their home schools, rather there was an expectation of partial knowledge construction by the students. Following the 2000 *NCTM Principles and Standards for School Mathematics*, the approach promoted student ownership of learning. When problem solving, students were often asked to interpret their numeric solutions within the context of the presented problem. Enrollment at Caldwell Academy changed the way students thought about

mathematics and problem-solving. There was a shift from algorithmic skill and performance through repetition to conceptual understanding and application. Mathematics success at Caldwell Academy required not only arriving at a particular numeric answer, but developing the ability to interpret numeric answers in the context of a presented problem and articulate their knowledge through written and oral communication.

Jackie was the only student in the study who enrolled in higher-level mathematics courses. She, too, admitted to putting in more effort at Caldwell Academy with lower academic performance. Jackie was better able to verbalize her difficulty. Until she had what she referred to as “an epiphany” she “liked [math] because of the formulas. So if I did something in class, that was the way I expected it to be done on the homework, on the test, and I could learn that way and do it. But in Calculus that wasn’t necessarily true.” She went on to say “up until that point I cheated and just made [a problem] into the way I learned and just made it into a formulaic type of math.” During her junior year she began to sketch illustrations when solving problems and spent a large majority of her time outside of class studying for Calculus. She visited her instructor frequently and was prepared to ask specific questions about topics during those appointments. Eventually, her work and commitment paid off because she was no longer thinking of mathematics as pre-determined sets of rules to be followed and began to think about problems from different angles. This change in her thought process demonstrated more conceptual than procedural understanding of the topics covered in Calculus.

Students in the study did not feel any less smart because their academic performance was no longer a self-reported 10 out of 10. They reported an increased difficulty of the type of mathematics they were expected to learn and the ways in which they were forced to communicate their knowledge. According to Patricia, Jackie, and Kyra, some students who possessed natural mathematics talent, while others were able to be successful in mathematics with large amounts of work and practice. All three attributed their mathematics success to work ethic. They spent significant time completing daily homework assignments, solving extra problems, and studying for tests. They also worked on understanding when concepts were not immediately clear to them.

The students' levels of efficacy greatly affected how they were able to manage difficulty in mathematics courses. When asked during the focus group how they reacted to and got through such difficulty, students' responses varied. Lewis' initial response was that "you do your work." He believed that by committing oneself to completing assignments, the goal could be accomplished. Tyrone took an introspective approach and assessed his own personal strengths, maintaining a belief that he was capable of being successful. He worked through his academic difficulties on an individual basis. Kyra and Lewis mentioned having to change their academic strategies. In their previous classroom environments they were accustomed to working independently, as are many high-achieving students. At Caldwell Academy they learned "how to talk to [their] teachers and peers and work with other people to figure stuff out. Especially

when it's more challenging." They both felt stronger after changing their strategy from an individualistic to a collaborative style.

During the focus group study participants revealed that they did not feel their home schools prepared them for the classroom environment and academic rigor within the mathematics department at Caldwell Academy. However, after two years at the school, they felt able to speak intelligently about mathematics and interpret numeric answers within the context of specific situations.

Furthermore, they were more able to work well in small groups, such as those in the mathematics courses at Caldwell Academy.

The students in the study all felt they were "good" at mathematics, but many did not meet their own definitions of a "good mathematics student," which they provided during their interviews. Jená described a good mathematics student as one who was willing to spend time working on problems when they proved difficult, but she refused to work on a problem for any more than approximately 15 minutes. If there were any mathematics that she did not know by her senior year, she was not going to know it (and had no desire to learn). According to Lewis, a good mathematics student would do more than complete daily homework; when studying, a good math student would also regularly review notes and work extra problems. The majority of participants reported performing to their ability in mathematics, which aligns with the work-ethic mentality behind performance.

Two of the six participants in the study, Jackie and Patricia, were from high schools in larger congressional districts in the state. At those larger schools

existed more opportunities for rigorous mathematics advancement than smaller, rural communities. Jackie was enrolled in courses beyond Calculus, but did not enroll in more than one math course each grading period. Patricia was the only participant in the study who enrolled in two mathematics courses each grading period of her senior year, Calculus and Statistics.

When asked about their self-perceived ability to take and pass the higher-level courses that were offered at Caldwell Academy, most students felt they could pass the courses. They were not intimidated by the topics covered in classes such as Mathematical Modeling and Number Theory. The participants maintained high levels of self-perceived ability despite their lack of enrollment in higher level courses. They chose courses that would primarily benefit their post-secondary interests, but did not go beyond Calculus. The most common sentiment among the students was that higher level mathematics was not required for their post-secondary academic and career plans. Anticipated majors of the students in the study included psychology, business, and medicine. Kyra was considering operations research and/or business, but did not anticipate needing mathematics beyond Multivariable Calculus, which she would take in college. Tyrone indicated an interest in physics, the major most closely related to mathematics.

The focus group directly addressed the lack of enrollment in mathematics courses the study participants felt they could successfully complete. Their rationales for not enrolling in the courses involved misunderstanding the pre- and co-requisites for the courses, and having no desire to take multiple mathematics

courses in a single grading period. When corrected about their misconceptions about courses such as Problem Solving, which did not require Calculus, and Mathematical Modeling for which Calculus is a co-requisite, the students elaborated on their reasons. Lewis felt swamped after taking Calculus during the entire academic year. Three trimesters of Calculus were required to take the Advanced Placement (AP) exam, which many students wanted to do. Scoring well on the AP exam would give the students college credit for completing either one or two semesters of Calculus. For many of the study participants, getting college credit by taking the AP exam met the mathematics requirements of their intended majors.

After enrolling in three trimesters of Precalculus and three trimesters of Calculus to be prepared for the Calculus AP exam, Tyrone could not see himself “doubling up” in mathematics, or concurrently enrolling in two mathematics courses. When asked during the focus group what could be done to increase interest in taking advanced mathematics classes, Tyrone suggested possible (college) credit for mathematics courses, yet not have those courses count towards each student’s GPA.

Support Systems

The racial identity of African-Americans in middle adolescence has been found to affect their social identities (Tatum, 1997) and peer group selection (M. L. Clark, 1991; Hamm, 2000). At their home schools, half of the study participants had primarily White circles at schools and African-American after-school/weekend social peer groups. The classes in which they were enrolled, particularly mathematics courses, were advanced classes with few African-American students. The participants were able to work well within the classroom, but many chose a different group of students to associate with outside of the classroom. Tatum (1987) describes this phenomenon among African-American adolescents who prefer to spend their personal time with others who can relate their experiences, particularly as they progress through the stages of racial identity development.

The students in the study chose peer groups at Caldwell Academy to whom they turned for academic and social support. For some, there was no difference between the social support networks they had created at their home schools and those that were formed at Caldwell Academy. For others, the racial composition of their peer groups shifted from racially mixed to primarily African-American upon enrollment. The participants also mentioned adults at the school who acted as mentors and others from their home communities to whom they remained connected.

Five of the six students in the study appeared to be in the internalization/commitment phase of identity development, which is not typical of

students in middle adolescence. This suggests that the residential high school living-and-learning environment creates an atmosphere similar to college, where a large number of African-Americans transition into internalization/commitment. During internalization/commitment, students are able to accept positive and negative images of African-Americans, process those images, and internalize what they feel is necessary to define themselves racially. Regardless of their phase in development, all students in the study recognized the importance of ignoring racial differences and working with others to study and understand difficult concepts. However, outside of class their peers groups were not always as diverse. The participants stated in their interviews that they did not study with their friends to avoid being distracted from the task at hand, but they still received support from them about academic issues. Their mathematics experiences were similar to those of their friends regardless of the specific courses in which they were enrolled.

Study participants largely relied on their friends at school for academic support, but they also established relationships with school personnel who were able to offer support. In the focus group, Kyra shared that during a time of personal difficulty she received the support she needed from her family and adults at the school who acted as mentors. When she felt she could not be successful, teachers and friends helped her realize she could remain at Caldwell Academy and be successful. Tyrone and Lewis agreed with her sentiments. Lewis was quite comfortable establishing relationships with his teachers and

shared both personal and academic issues with them. He felt teachers were willing to be of assistance because they cared about his situation.

Lewis's MIBI responses demonstrated a nationalist ideology. This ideology would account for his feelings about the social atmosphere of the school and his peer group selection. Lewis felt that the small percentage of African-American students at the school was reason for African-Americans to socialize and create solidarity. He described his peer group as solely African-American. Jená and Tyrone also chose African-American peer groups because these were the people with whom they felt most comfortable, but their responses to the MIBI assessment corresponded more to a humanist ideology. The humanist believes that people should be seen as humans first and falls in line with the strong spiritual influence in both their lives. Jená and Tyrone were not suspicious of others, nor did they express dislike; they were simply more comfortable with African-Americans. Although Tyrone could be categorized as a humanist, there was a shift between his social peer group at his home school and the one he created at Caldwell Academy. His social group at Caldwell Academy became less diverse because the majority of the African-Americans at his home school "were up to trouble" and he chose to surround himself with others with goals; those were not necessarily African-American students at home.

Patricia, Jackie, and Kyra did not demonstrate any shift in their social circles after enrolling at Caldwell Academy. They possessed different views about how they chose their peer group than Jená, Lewis, and Tyrone. Patricia had diverse study and peer groups both at her home school and Caldwell

Academy. Jackie and Kyra were roommates and close friends who shared views on choosing friends. The girls did not feel pressured to spend time with African-American students solely because of shared racial identity. They preferred to include people who had similar interests and motivations in their peer groups.

Jackie stated:

I don't make a habit of being around just Black kids here because ... I feel like their personalities are not the people that I would be around if I was at home. I don't necessarily feel a responsibility to be with them because we're all Black. I'd rather be with the people who are like the people that I was with at home ... a lot of those kids that have the personality that I like happen to be White. I think ... if we were at my old school, like if we would have been friends. And a lot of times it's not the case.

The existence of strong family and parental influence in the life of an African-American adolescent can be just as important in the development of resilience as self-efficacy and other types of support systems (M. L. Clark, 1991; Floyd, 1996; Nettles, 1993; Winfield, 1991). For some students in the study, parental influence emerged as a component of their support systems – affecting their self-concept and academic confidence.

Kyra's parents encouraged her to be the best student and person she could be. Through their influence, she was determined not to be categorized into a certain group or as a certain type of person. Kyra consistently expressed a desire to be the best student, not the best African-American student, and did not want to be viewed as such by administrators, teachers, or other students.

For Jackie, the strong presence of her mother instilled a belief that she was smart and could achieve her goals. In her autobiography Jackie said "My mom [helped me realize I was good at math]. My teachers always seem

surprised.” From a young age, Jackie’s mother verbally affirmed her intellect, so being challenged by others did not have an impact on how she perceived herself. Jackie’s mother fought resistance to have Jackie tested and placed in advanced classes. Once in those classes, Jackie’s mother continued her support, particularly when Jackie was in potentially discouraging situations. At Jackie’s private school where she was one of few African-American students, Jackie felt others expected very little of her, but her mother constantly encouraged excellence.

Surmounting obstacles for students in the study was a result of their academic and personal resilience. Self-efficacy and support systems are both factors contributing to their ability to work through academic difficulty and personal situations that may affect performance. This resilience resulted in their mathematics success at Caldwell Academy and they were able to successfully complete both their junior and senior year mathematics courses. However, for the majority of the students in the study, their choice of mathematics courses did not include the higher-level courses available at the school.

Research Questions

The purpose of the study was to address the mathematics course enrollment history of African-American students by answering the following questions:

1. How confident do African-American students feel about their ability to successfully complete mathematics courses?

2. What academic and social strategies do mathematically successful African-American students employ?

3. What type of shift occurs in the development of racial and social identity of African-American adolescents at a specialized, residential high school?

Students' self-perceived ability to be mathematically successful was revealed through their mathematics autobiographies and responses to individual interview and focus group questions. Items from each collection method addressed how confident mathematically capable students felt about their ability to successfully complete mathematics courses before and after enrollment at Caldwell Academy, as well as their self-perceived ability to pass higher level mathematics courses. The students in the study voiced a perceived increase in academic effort with lower academic performance at Caldwell Academy than at their home schools. The majority felt they were performing to their ability, and those who were not believed their performance would improve with increased effort. When questioned about their self-perceived ability to successfully enroll in advanced mathematics courses, the students felt able to do so. They attributed their primary reason for not enrolling in advanced mathematics courses to post-secondary academic and career interests that required no more mathematics than they had taken. However, students also expressed feelings of mental exhaustion as a result of enrolling in mathematics courses each grading period.

The second research question was posed to reveal the academic and social strategies employed by the mathematically successful students in the study. This question was answered by interpreting responses to items in the

individual interviews and focus group. The study participants were forced to work and study differently at Caldwell Academy than at their home schools. The classes at Caldwell Academy required more conceptual than procedural understanding and were configured in small working groups where each student was expected to contribute equally to discussions and class activities.

All of the students felt able to be successful; and attributed their mathematics success to natural ability and other factors. By their reports, they worked hard, used department resources, and relied on friends and family for support. All of the students in the study reported that they primarily studied alone. Students developed attitudes of self-reliance to work through difficult academic situations; Tyrone maintained a belief that he was successful. Half of the study participants were aware of family and friends in their home towns who held high expectations for them. Kyra quoted the old adage “to whom much is given, much is expected.” She and the other students recognized how much of an opportunity they were given by enrolling at Caldwell Academy and almost felt as though they had no other choice than to succeed. They also put pressure on themselves to succeed and used that pressure as a driving factor when they felt overwhelmed.

After dealing with issues of pride, the students were able to comfortably approach their teachers for help and to work with others in their classes to understand material. Even though students would work with classmates, many would rarely study with friends in their social circles, for fear of getting off task. However, they did rely on their friends for encouragement and support in both

academic and personal situations. The kindness, understanding, and encouragement of others – friends and school personnel – played a large part in the resulting mathematical success of the participants in the study.

The last research question investigated what, if any, shift occurred in the development of racial and social identity of mathematically successful African-American students at Caldwell Academy. Enrollment at Caldwell Academy precipitated a shift in the social circles of half of the study participants. Three of the six students had racially mixed groups at Caldwell Academy; the other half reported completely African-American peer groups. Inside the classroom, the study participants most frequently worked with White students. As a result of student enrollment figures, their mathematics classes were primarily White and students were able to work with their classmates, regardless of their peer group choice. Jackie was the only African-American enrolled in her mathematics class, thus her success in class relied on working with non-African American students. Outside the classroom, students gravitated toward the type of peer with whom they felt most comfortable. Patricia, Jackie, and Kyra had diverse groups of friends, similar to the groups they had at home. For them, there was no shift.

In contrast, Lewis, Jená, and Tyrone created primarily African-American social circles at Caldwell Academy. They evolved from having two separate types of social circles (class vs. home) to surrounding themselves primarily with African-American students. For Jená and Tyrone, the selection was a matter of spending time with others who shared religious and spiritual beliefs. Before attending Caldwell Academy, Tyrone would have spent more time with the

African-American students he knew at home, but they were “up to no good” and he chose to include others in his social circle; the African-Americans at Caldwell Academy were motivated and had goals to which he could relate. The driving force behind Lewis’ association with other African-American students was the solidarity of African-Americans; they shared interests, goals, and experiences.

The students’ phase of racial identity and MIBI subscale scores were thought to be influential to the types of social circles they created at Caldwell Academy. However, many of the study participants appeared to be in internalization/commitment phase of nigrescence, but had different types of social circles. The students had clearly incorporated mainstream education values, based on their records of academic achievement. However, they expressed and demonstrated varying levels of comfort with incorporating non-African Americans into their social circles.

In summary, portraits of each study participant were painted using their words and sentiments from the data collection instruments. Their commonalities were developed into themes contributing to their academic resilience at Caldwell Academy. Their portraits and the findings answered the research questions that tie to the course enrollment history of African-American students at Caldwell Academy. The next chapter concludes the study with a summary, discussion of the findings, and implications for African-American mathematics education at Caldwell Academy.

Chapter 5: Discussion

This chapter presents a summary of the study, a discussion the findings, the implications for future mathematics course enrollment of African-American students, as well as the limitations and recommendations for future research, and a conclusion for the study. The summary revisits the purpose, methodology and results of the study. It also revisits the research questions. Discussion of the major themes resulting from data analysis evolves into implications for mathematics success of African-American students. Lastly, I address limitations of the current study and suggest recommendations for future research based on those limitations.

Summary

The lack of African-American enrollment in higher level mathematics courses at Caldwell Academy, a specialized, residential high school in Southeastern US was the underlying topic and driving force of the current study. To arrive at the heart of the matter, I investigated mathematics efficacy, academic strategies, and racial identity and social strategies of African-American students with records of mathematics achievement. Analysis of existing school data on enrollment over a 5-year period identified trends in mathematics course enrollment among African-American students. The goal was to create portraits of

each of the students in the study in their own words and then enhance their portraits with objective data.

Academic resilience served as the primary theoretical framework because the students in the study have proven themselves to be mathematically successful by school standards. Their previous academic success, which gained them admission to Caldwell Academy, was shared by others at the school, making them no longer unique after enrollment. This mathematics success was a testament to their abilities to establish themselves academically and to flourish in Caldwell Academy's rigorous environment. By being mathematically successful, the students in the study shattered the image of the African-American student who fears "acting White". They used their records of academic achievement to their advantage to apply to and enroll in Caldwell Academy, a specialized, residential high school. Once at the school, the students created opportunities for themselves within the mathematics department, thus shattering stereotypical images African-Americans who shun their intelligence in favor of peer acceptance. Not only were the study participants not forced to choose between intelligence and peer acceptance, they used both to develop resilience in a rigorous, and sometimes stressful, academic environment.

Listening to and recording the voices of mathematically successful African-American students is necessary to populate the body of literature about such students. Studies about African-American students who achieve mathematics success can be used to identify supportive factors and programs for African-American students in similar situations at other schools. The information

gleaned from such studies can also be used to increase the possibility of mathematics success for other students.

A phenomenological research methodology, which uses the words of the participants to convey their experiences, was employed to capture the heterogeneity of each African-American student's experience. Mathematical autobiographies, individual interviews, and a focus group provided information about each participant's lived experiences in his or her own words. Their individual voices were used to paint descriptive portraits of each student. The portraits, largely based on the qualitative data received from each student, were augmented by their responses to the Multidimensional Inventory of Black Identity (MIBI). MIBI responses indicated the centrality of race for each individual, their private and public regard, and ideology.

Results of the research created descriptive portraits of African-American seniors at Caldwell Academy. All students invited to participate in the study were mathematically successful by school standards and eligible to enroll in higher level mathematics courses. Six of the 14 eligible African-American students in the senior class at the time of the study received parental consent and/or agreed to the study. Of the six students, one was enrolled in a higher level mathematics course. She began her first year at the school enrolled in Calculus, while the majority of students entering Caldwell Academy enroll in Precalculus. Another student in the study was simultaneously enrolled in two math classes during her senior year at the school, neither was considered higher level.

The portraits of the participants revealed two themes that tie back to the primary framework of academic resilience: academic efficacy and concept and support systems. Both themes have been found to contribute to the academic resilience of African-American students (Floyd, 1996; Steward, 1996). Thus, the development of academic resilience includes internal motivating factors as well as external factors supporting and influencing their ability to persevere.

The next section of the chapter discusses the findings as they relate to the research questions and literature. Each of the questions is addressed using the results of the study, interpreted by the researcher.

Discussion

The larger context of the study was the mathematics course enrollment history of African-American students at a specialized school. The enrollment of students in the study was typical of the trend identified in a 5-year analysis of course enrollment history. The majority of African-American students at Caldwell Academy have historically graduated from the school without enrolling in higher level mathematics courses.

Research has shown that nationally African-American students are highly under-represented in advanced mathematics courses (Finn, 2002). In traditional schools, lack of enrollment in mathematics courses can preclude students from many post-secondary academic and career choices, particularly those emphasizing Science, Technology, Engineering, and Mathematics (STEM). At Caldwell Academy, students were required to enroll in mathematics during both

11th and 12th grade. They are also required pass Precalculus if they do not begin their enrollment at the school in a higher mathematics course. The obstacles to advanced course enrollment at Caldwell Academy were different from those at traditional schools. Examining students nationally, Finn, Gerber & Wang (2002) found that mathematics course offerings were largely tied to a schools' expectations for students. Their study found that as the proportion of minority and low SES students in a school increased, the higher level mathematics course offerings were found to decrease. At Caldwell Academy, the students were chosen based on their academic ability as they compared to students in their state congressional districts; the resources at Caldwell Academy resulted from state tax dollars, not individual school district income levels. This suggests that low enrollment statistics in higher level mathematics courses were a result of other factors beyond local economic resources.

To address the lack of enrollment in advanced mathematics courses, I designed the study to delve into the students' levels of mathematics self-efficacy, academic and social strategies, and social identity development. The first research question addressed the mathematics self-efficacy of the study participants. The students in the study had passed Precalculus with a B- or higher and study were viewed as mathematically successful by the school's definition. All of the participants were enrolled in mathematics courses each grading period, one more than then dictated by graduation requirements at their time of enrollment, but many did not simultaneously enroll in multiple mathematics courses or enroll in advanced courses.

I was forced to address my preconceived notions about enrollment participation when beginning the study and attempting to answer the first research question. As a graduate of a similar institution, I recalled my own mathematics experiences. I was also in the minority at the school I attended and was the only African-American enrolled in a course on mathematical modeling. My decision to enroll in the course was based on curiosity and interest in solving common issues using mathematical models. My initial assumption in designing and collecting data for the study was that the participants who did not enroll in higher level mathematics courses failed to do so because they did not feel efficacious or were not explicitly encouraged by faculty. However, through the subsequent analysis and reflection, a shift in interpretation occurred.

Study participants appeared to know which courses would be most applicable to their interests and enrolled accordingly. However, their focus group responses implied that factors such as work load and intimidation contributed to their lack of enrollment in higher level courses. During the focus group Lewis commented about using all his mental energy on Calculus and not having the strength to take additional mathematics courses, while Tyrone suggested having courses that did not count towards students' GPA to increase interest in higher-level mathematics courses. These statements strongly imply two issues: the students did not want to exert the mental energy to be successful in advanced mathematics courses; and despite their statements of perceived self-ability, students were not certain they could be successful in advanced courses. Study participants who were enrolled in Precalculus during their junior year and

Calculus their senior year were able to be successful in those courses by school standards. However, the increased effort and ability required by higher level courses seemed to intimidate many of the participants in the study. Thus, the students' words conveyed confidence, but their actions (course enrollment) suggested otherwise.

More than one student in the study mentioned the State University tuition grant as incentive to attend Caldwell Academy. Because many of them had post-secondary interests outside of mathematics, attending Caldwell Academy for the mathematics rigor was not considered. However, Tyrone, Lewis, and Jackie had science-based interests that would benefit from concurrent enrollment in science courses, not mathematics. Other students stated interests in psychology and business. The tuition grant was a method for the study participants to defray the cost of attending college; the grant could be supplemented by any need-based aid and other scholarships to cover fees, housing, and books. Using the tuition grant to their advantage was these students' way of working within the educational system and being rewarded for their intellectual abilities. Attending Caldwell Academy guaranteed likely, but uncertain, financial assistance had they graduated from their home high schools.

It appeared as though the students in the study used the State University tuition grant to their advantage, but I posit other factors contributed to their lack of enrollment in higher-level mathematics courses. The students did not indicate a desire to enroll in the courses for self-edification despite their post-secondary interests. I suspect explicit encouragement to challenge themselves in the

courses may have generated different outcomes. Teacher expectations can also strongly influence the mathematics course enrollment choices made by African-American students (Jamar, 2005; Ndura, 2003; Rowser, 1994). The students in the study expressed frustration at not being thought able to academically perform as well as, if not better, than their White counterparts. Resilient attitudes by the students in the study enabled them to create mathematics opportunities for themselves by successfully completing their junior year mathematics course. However, their lack of enrollment may be partially attributed to their perception of teacher expectations. Because research has shown that teacher expectations are influential, I posit the absence of direct communication also influenced course enrollment choices of the study participants. Study participants largely felt teachers were surprised when they were successful and felt they had to work harder than their White counterparts. Furthermore, because teachers did not directly communicate expectations of participation in higher level classes, students saw no benefit to enrollment, nor its applicability to their future academic and career plans. Career interest in STEM fields is positively related to mathematics self-efficacy (O'Brien, 1999) and for the students in the study, I believe the manifestation of mathematics self-efficacy in terms of course enrollment choices was related to teacher expectations as well as their self-perceived levels of mathematics ability.

Without the direct encouragement from faculty, enrollment in higher level mathematics courses at Caldwell Academy largely appeared to be a result of the resources available to them and the mathematics courses they took at their

home school. Within the state, the academic resources at schools were largely affected by the size of the congressional district. Students from the sample years of analysis who enrolled in higher level mathematics courses were enrolled in Calculus their junior year. Successfully completing Calculus created more opportunities for course enrollment during their senior year. Graduation requirements at Caldwell Academy required a student be enrolled in at least one mathematics course each grading period. The eligible students from the sample enrolled in advanced mathematics courses *after* completing Calculus. This suggests that the students who enrolled in advanced courses did so as a result of completing Calculus during their junior year and did not choose to make a lateral move to courses such as Statistics.

The academic and social strategies employed by the participants in the study were the protective mechanisms and methods by which they remained resilient. Academically, students tapped into their internal motivation, worked with other students, and approached mathematics faculty to become mathematically successful. The students all felt they were smart – before and after enrolling at Caldwell Academy – but had to work harder to be successful at Caldwell Academy. In addition to adjusting to the academic rigor at the school, students were faced with other challenges to their mathematics success. Lewis perceived African-American students as not being expected to handle the academic rigor well enough to perform at the same level as their White counterparts. In the focus group, he stated African-American students were required to go

to greater extents to prove their ability to be successful, citing the “Black tax.” He thought African-American students were accustomed to doing extra work and that they did it to reach their goals, sentiments shared by others in the focus group.

Despite individual academic and larger perceived racial challenges, the study participants were able to surmount obstacles by relying on their friends, family, and school personnel in addition to their own abilities. Use of the support systems, like the ones they created, is a coping strategy employed frequently by resilient African-Americans with histories of achievement (Floyd, 1996; Lee, 1991; Steward, 1996). Students in the study established relationships with faculty and personnel at the school who helped them through difficult academic and personal situations. Kyra specifically mentioned her physics teacher, an African-American female from whom she frequently sought guidance. Not only was this teacher able to counsel Kyra, but she served as an example of mathematics and science success for other African-American students at the school. Cultural reflection in the presence of personnel acting as role models has been found to positively influence African-Americans (Jay, 2005; Moody, 2004).

Socially, the students at Caldwell Academy created circles based on the aspects of their identities that were most important to them. The successful creation of social support systems for African-Americans can positively contribute to their resilience and resulting ability to be

academically successful (Clark, 1991). When forced to choose peer groups based on academic orientation or racial identity, research has shown that many African-American adolescents prefer to be accepted by other African-Americans (Hamm, 2000).

Lastly, to address any shift in racial and social identity, I liken enrollment at Caldwell Academy to a qualitative study where academic orientation has been controlled to determine where the primary interests of African-American students emerge when choosing peer groups. When strong academic orientation is no longer a factor, students could choose their peers based on other factors; for some students race was more important, for others it was important to have shared interests and ambitions. This preference precipitated a shift in the racial composition of half the participants' social circles after attending Caldwell Academy. Regardless of how they chose their peer groups, the study participants relied on their friends when they were faced with academic and personal difficulty. This reliance has been found as a strategy contributing to the resilience of high-achieving African-American students (Floyd, 1996; Steward, 1996). Their friends were able to offer encouraging words or companionship to assist with unfavorable issues.

The pattern of African-American enrollment in higher level mathematics courses raises the following questions: (a) Is it detrimental to the academic experience of African-American students if they do not enroll in advanced mathematics courses?;(b) Is it necessary to increase African-American participation in higher level mathematics courses?

The trend of low levels of participation in higher level mathematics courses is typical of students in the study. However, African-American students from Caldwell Academy have found post-secondary educational success with the mathematics course enrollment choices they made. Students in the current study are evidence of that success. The participants in the study include Kyra, an African-American female who enrolled in Calculus during her senior year and did not enroll in multiple mathematics courses. Kyra received a prestigious scholarship to an institution in the State University System. The award required strength in three areas: academics, athletics, and leadership. Jackie, who enrolled in higher level mathematics courses, received an honors scholarship to attend a reputable private institution in the state. Other study participants have gone on to attend other institutions in the State University System and one participant chose to attend a private Historically Black College in Georgia. The students were also offered enrollment and merit-based scholarships to other schools they did not choose. Their course enrollment choices did not preclude their acceptance and attendance to reputable post-secondary institutions. Increasing African-American participation in higher level mathematics courses is not necessary for African-American students to successfully graduate from Caldwell Academy. However, increased levels of participation may result in even higher levels of mathematics self-efficacy among African-American students and increased interest in mathematics-based post-secondary academic and career choices.

Implications for Teaching African-American Students at Caldwell Academy

Although it does not appear necessary for African-American students to participate in higher-level mathematics courses, the low levels of enrollment were of concern to the head of the mathematics department. To increase enrollment in higher level mathematics courses, it is necessary for the mathematics department to make the courses appealing to mathematically talented and successful African-American students.

Increasing diversity in advanced mathematics courses could prove difficult at Caldwell Academy within its current graduation requirement structure. Students must enter their junior year at Caldwell Academy in Calculus or higher to have the opportunity to enroll in higher-level mathematics courses without concurrent enrollment in two mathematics courses during their senior year. If the feelings about heavy workload and intimidation implied by study participants are shared by other African-Americans, the level of academic ability and energy required to be successful in higher level mathematics courses is of concern to them. Interpreting the responses to interview and focus group questions, I posit that students view the courses as those attempted by only the best students, not by simply “good” students. They do not attempt to enroll in the courses because they do not feel able, despite their self-reported levels of ability. The challenge for educators, then, is to convince students that they are able.

Upon enrollment at Caldwell Academy African-American students who were formerly unique by virtue of their previous mathematics achievement become “average.” This makes them subject to a system of stratification within

the mathematics department where higher level courses are perceived to be geared toward the best mathematics students. Many study participants described themselves as “average” when asked about their mathematics ability at Caldwell Academy. They did not doubt their own intellectual ability, but recognized that other students at Caldwell Academy demonstrated more natural talent in mathematics.

This perception has serious ramifications for mathematics educators at Caldwell Academy. As long as higher level classes are perceived to be unattainable, participation will continue to be low for African-American students. In addition to contributing to the academic resilience of African-Americans, teacher communication and influence can affect the course enrollment choices of minority students (Jamar, 2005; Ndura, 2003; Rowser, 1994). The school strongly emphasizes NCTM Principles and Standards' (2000) suggested practice in regards to classroom communication and student knowledge construction, such as building mathematical understanding through problem-solving and applying mathematical knowledge to other content areas. Along with the Standards, NCTM Principles are suggested practice. Per the Equity Principle, high expectations and strong support for all students in mathematics contribute to excellence in mathematics education. To increase diversity representation in advanced mathematics courses, the Principles (NCTM, 2000), addressing equity must be more strongly emphasized at Caldwell Academy.

Limitations of the Current Study

As the details of the collected data and themes emerged and the research questions were answered, I realized other information that could have been collected and ways in which the study could have been improved. I identified limitations of the current study analysis of the data and reflection. Addressing these limitations has allowed me to make recommendations for future research.

The current study was subject to several limitations: sample size; type of participant data. The current study used a small segment of the African-American population at a specialized school to answer the research questions. Less than half of the students invited to participate in the study agreed, limiting the variety of responses that would have resulted from including the entire African-American student population meeting the study criteria. The small sample size was not adequate for creating a mixed methods study, thus the experiences of the participants were investigated using a phenomenological methodology to capture the unique experiences of each student meeting the selection criteria. Data collected from the students' words and academic records were used to create each portrait. The depth of the study and each portrait could have been increased by collecting information on student family backgrounds including, but not limited to: parent marital status, parent level of education, number of siblings and level of education, and socio-economic status.

Recommendations for Future Research

From the limitations of the current study, I identified recommendations for other studies based on the same theoretical framework. A comparative

qualitative study using non-African American students with the same criteria can provide a control group. Such a comparative study can identify any similarities or differences in advanced course enrollment among the total school population. From those comparisons it would be possible to determine if the trend among African-American students was typical or different from that of all students.

A longitudinal study of students beginning with the last grading period of their junior year and ending in college can provide much more information about the impact of mathematics course enrollment. By the last grading period of their junior year, students are generally certain about the mathematics course(s) they plan to take their senior year. Interview items about academic and social adjustment would be appropriate at that time. During the senior year, a series of interviews addressing each student's progress through their mathematics courses, the post-secondary application process, and undergraduate major decisions could be conducted in-depth. These interviews could allow the researcher to gather information from students as they prepared for and took mathematics tests and exams to get more accurate information about study habits and work ethic. Maintaining contact with the students after graduation from high school can provide the opportunity for students to state the impact of their mathematics course enrollment on their undergraduate majors. The participants would be able to knowledgeably discuss their preparedness for the work ethic required in college, as well as preparedness for participating in post-secondary mathematics courses.

The research in this study can serve as the stepping stone for increasing the body of literature dedicated to mathematically-successful African-American students. Qualitative studies like this one can delve deeper into the academic and social strategies contributing to success. Larger studies can be used to make the results more generalizable both to African-Americans with records of mathematics achievement and African-Americans at specialized high schools. Other qualitative studies can investigate not only the mathematics self-efficacy of African-Americans, but their individual, specific problem-solving methods and activities within the mathematics classroom. Mixed methods studies can investigate quantitative data such as MIBI responses, SAT scores, and student-level data. The results of all types of studies can be used to inform educators and administrators about the types of influential factors and academic and social environments contributing to success.

Conclusion

Presented here were the portraits of mathematically successful African-American students. Prior to enrolling at Caldwell Academy, a specialized residential high school, they established records of mathematics achievement. Their strong academic records contributed highly to their success at the school by influencing their self-perceived ability to do well.

The students at Caldwell were atypical in the sense that they are highly talented in mathematics with demonstrated records of achievement. Their performance was contrary to the national trend from most recent NAEP

assessments; they were breaking the rules of underachievement for African-Americans. However, the study participants were typical within the context of mathematics course enrollment history at Caldwell Academy. The study participants were eligible to enroll in higher level mathematics courses, but many did not; here they follow the trend.

As African-Americans in middle adolescence, the students in the study were developing social identities in combination with their racial identities. Often one of few African-Americans in their mathematics courses, they were able to work with others in the classroom to achieve their academic goals. Outside the classroom, students choose their peer group based on the student population with whom they felt most comfortable. Regardless of their peer group selection, study participants not shun their academic success in favor of peer acceptance.

The participants in the study employed a variety of academic and social strategies to manage difficult situations. They worked inside a population of achievers to maintain their academic strengths and establish social connections with others for support. Successful employment of academic and social strategies built resilience, strengthening their ability and desire to persevere. The students in the study remained academically resilient regardless of their mathematics course enrollment choices. Their ability to become mathematically successful by school standards in light of their minority status is a direct result of their ability to persevere. The mathematics ability and work ethic required to be successful in their mathematics courses did not deter them from creating opportunities for themselves in the mathematics department. Although many of

the participants the study, and during the years of the analysis, did not enroll in advanced mathematics courses, their choices did not hinder their post-secondary aspirations. As mathematically successful African-American students, they continued to shatter stereotypes and preconceived notions about African-Americans in all schools.

The results of this study are based on phenomenological portraits of six mathematically successful African-American students and may not be generalized to all African-Americans. However, the current study design and methods employed can be used to initiate investigation into the factors contributing to the mathematics resilience of high-achieving African-American students.

Appendix A: Parent Consent Form

University of North Carolina-Chapel Hill Parental Permission for a Minor Child to Participate in a Research Study Social Behavioral Form

IRB Study # 06-0046

Consent Form Version Date: 12 April 2006

Title of Study: Breaking All the Rules: Portraits of Mathematically Successful African-American Students

Principal Investigator: Dedra Eatmon

UNC-Chapel Hill Department: School of Education

UNC-Chapel Hill Phone number: N/A

Email Address: deatmon@email.unc.edu

Co-Investigators: N/A

Faculty Advisor: Carol E. Malloy, Ph.D.

Funding Source: N/A

Study Contact telephone number: Dedra Eatmon, 919.416.2740

Study Contact email: deatmon@email.unc.edu

What are some general things you should know about research studies?

You are being asked to allow your child to take part in a research study. To join the study is voluntary. You may refuse to give permission, or you may withdraw your permission for your child to be in the study, for any reason. Even if you give your permission, your child can decide not to be in the study or to leave the study early.

Research studies are designed to obtain new knowledge. This new information may help people in the future. Your child may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Details about this study are discussed below. It is important that you understand this information so that you and your child can make an informed choice about being in this research study.

You will be given a copy of this permission form. You and your child should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

The purpose of this research study is to learn about the academic and social experiences of mathematically successful African-American students at specialized, residential high schools.

Your child is being asked to be in the study because he/she has successfully completed Precalculus and has enrolled in Calculus (or a higher level mathematic course) at Caldwell Academy.

How many people will take part in this study?

If your child is in this study, your child will be one of approximately 10 people in this research study.

How long will your child's part in this study last?

Your child's participation in the study will take approximately 6 weeks. The individual participatory elements (mathematics autobiography, questionnaire, and interviews) will occur over a 4-week period with a focus group of all participants approximately two weeks later. Your child's participation in the study should be complete by the end of May 2006.

What will happen if your child takes part in the study?

Once your permission is received for your child to participate in the study, she/he will be asked to write a mathematics autobiography, complete a racial identity assessment, participate in an individual interview and participate in a focus group. The mathematics autobiography will take approximately one hour. It asks your child to reflect on his/her mathematical experiences and to make comparisons between mathematics at his/her home school and Caldwell Academy. The assessment will take about 15 minutes and contains items to which your child will agree or disagree on a 7-point scale. Sample items include items such as "In general, being Black is an important part of my self-image" and "Being black is an important reflection of who I am." When completing the assessment, your child may choose to not respond to an item for any reason.

The interview and focus group(s) will last approximately 30-45 minutes. The interview will take place at a mutually convenient location. It will cover your child's mathematical and social experiences both prior to and since enrolling at Caldwell Academy. With your and your child's permission, the interview will be audio-taped and transcribed. Your child will have the right not to answer any question for any reason. Questions for the focus group will come from information gained during the individual interviews, such as common mathematics and social experiences shared by participants. If at any time your child requests to withdraw from the study, the request will be granted.

What are the possible benefits from being in this study?

Research is designed to benefit society by gaining new knowledge. Sharing her/his experiences and methods for mathematical success may help your and her/his peers gain insights and understandings that are of benefit to her/him.

However, your child's experiences as a successful mathematics student will inform educators and policy-makers of the strategies and environments that foster mathematics success among African-American students.

What are the possible risks or discomforts involved from being in this study?

Although there are no known risks to participating in this study, your child may feel some uneasiness in describing any challenges he/she may have faced in academic or social circles. Recounting experiences that have brought him/her to their current academic status may be difficult for some.

As an educator and researcher, I will do my best to make your child as comfortable as possible. I will conduct interviews and focus groups in an environment that is open, comfortable, and private, where your child can feel secure about any emotions and experiences that are divulged to the researcher.

There may be uncommon or previously unknown risks. You should report any problems to the researcher.

How will your child's privacy be protected?

In an effort to maintain privacy, your child's name will not be used on any audio-taped interviews or focus groups. If at any time during the interview, your child requests that the tape be turned off, that request will be honored. I will transcribe the tapes and they will be kept in a locked drawer in my office. I will also replace the names of any school, organization and/or community your child may mention with different names to protect her/his identity.

For the focus group, your child will be asked to choose her/his own pseudonym. The focus group will also be audio-taped for transcription at a later date. If your child is not comfortable with the taping, she/he may decline to participate. During the focus group, you may elect not to continue with the focus group, without penalty. To protect the privacy of other participants, your child must agree not to reveal anything learned from the focus group.

With your permission, data about your child's academic history will be obtained from the State Educational Data Research Center. Obtaining these data will require your child to provide her/his social security number and date of birth. Providing her/his social security number and date of birth on the assent form gives permission for her/his academic history to be released; omitting that information denies permission. Your child may participate in the remainder of the study regardless of your decision about releasing her/his academic history.

At the conclusion of the study, data will be retained and secured. All notes and records that contain your name or the names of any school, organization or community mentioned will be destroyed. They will be replaced with the pseudonym you chose as well as those created by the researcher to describe

your hometown, high school, friends, and teachers. Identifiers will be removed by late June 2006. Once successfully removed, the audiotapes will be destroyed.

In addition, your child will be offered a copy of the transcript of his/her interview and the focus group. I will be the only person in possession of interview and focus group audiotapes during the study. Audiotapes and transcripts will be kept in a secured location during the study.

Participants will not be identified in any report or publication about this study. Although every effort will be made to keep research records private, there may be times when federal or state law requires the disclosure of such records, including personal information. This is very unlikely, but if disclosure is ever required, UNC-Chapel Hill will take steps allowable by law to protect the privacy of personal information. In some cases, your information in this research study could be reviewed by representatives of the University, research sponsors, or government agencies for purposes such as quality control or safety.

Will your child receive anything for being in this study?

Your child will receive a small token, such as a USB flash drive, for taking part in this study. The inducement will be given to your child at the conclusion of the focus group. If your child decides to withdraw (or is withdrawn) from the study prior to completion, the inducement will be prorated to $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$ of the value of the token and an alternate item selected (e.g. a gift card). Food and refreshments will be provided during the focus group.

Will it cost you anything for your child to be in this study?

There will be no costs for being in the study.

What if you are a UNC student?

You may choose not to give permission for your child to be in the study or to stop being in the study before it is over at any time. This will not affect your class standing or grades at UNC-Chapel Hill. You will not be offered or receive any special consideration if your child takes part in this research.

What if you are a UNC employee?

Your child's taking part in this research is not a part of your University duties, and refusing to give permission will not affect your job. You will not be offered or receive any special job-related consideration if your child takes part in this research.

What if you or your child has questions about this study?

You and your child have the right to ask, and have answered, any questions you may have about this research. If you have questions, or concerns, you should contact the researchers listed on the first page of this form. Dedra Eatmon, Principal Investigator, can be reached via phone, at (919) 416-2740, or email

(deatmon@email.unc.edu). Carol Malloy, Ph.D., faculty advisor, can be reached via phone, at (919) 962-6607, or email (cmalloy@email.unc.edu).

What if you or your child has questions about your child's rights as a research participant?

All research on human volunteers is reviewed by a committee that works to protect your child's rights and welfare. If you or your child has questions or concerns about your child's rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

Parent's Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily give permission to allow my child to participate in this research study.

Printed Name of Research Participant (Child)

Signature of Parent

Date

Printed Name of Parent

Appendix B: Adolescent Assent Form

**University of North Carolina-Chapel Hill
Assent to Participate in a Research Study
Adolescent Participants age 15-17
Social Behavioral Form**

IRB Study # 06-0046

Assent Form Version Date: 24 March 2006

Title of Study: Breaking All the Rules: Portraits of Mathematically Successful African-Americans

Principal Investigator: Dedra Eatmon

UNC-Chapel Hill Department: School of Education

UNC-Chapel Hill Phone number: N/A

Email Address: deatmon@email.unc.edu

Co-Investigators: N/A

Faculty Advisor: Carol E. Malloy, Ph.D.

Funding Source: N/A

Study Contact telephone number: Dedra Eatmon, 919.416.2740

Study Contact email: deatmon@email.unc.edu

What are some general things you should know about research studies?

You are being asked to take part in a research study. Your parent, or guardian, needs to give permission for you to be in this study. You do not have to be in this study if you don't want to, even if your parent has already given permission. To join the study is voluntary. You may refuse to join, or you may withdraw your assent to be in the study, for any reason, without penalty.

Research studies are designed to obtain new knowledge. This new information may help people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

The purpose of this research study is to learn about the academic and social experiences of mathematically successful African-American students at

specialized, residential schools. The aspects of identity that will be investigated are peer group selection, academic orientation, and racial identity.

You are being asked to be in the study because you are an African-American senior at Caldwell Academy who has successfully completed Precalculus and is enrolled in Calculus or a higher level mathematics course.

How many people will take part in this study?

If you decide to be in this study, you will be one of approximately 10 people in this research study.

How long will your part in this study last?

Your participation in the study will take approximately 6 weeks. The individual participatory elements (mathematics autobiography, questionnaire, and interview) will occur over a 4-week period with a focus group of all participants approximately two weeks later. Your participation in the study should be complete by the end of May 2006.

What will happen if you take part in the study?

Once your permission is received to participate in the study, you will be asked to write a mathematics autobiography, complete a racial identity assessment, participate in an individual interview and participate in a focus group. The mathematics autobiography will take approximately one hour. It asks you to reflect on your mathematical experiences and to make comparisons between mathematics at your home school and at Caldwell Academy. The assessment will take about 15 minutes and contains items to which you will agree or disagree on a 7-point scale. Sample items include items such as "In general, being Black is an important part of my self-image" and "Being black is an important reflection of who I am." When completing the assessment, you may choose to not respond to an item for any reason.

The interview and focus group(s) will last approximately 30-45 minutes. The interview will take place at a mutually convenient location. It will cover your mathematical and social experiences both prior to and since enrolling at Caldwell Academy. With your permission, the interview will be audio-taped and transcribed. You will have the right not to answer any question for any reason. Questions for the focus group will come from information gained during the individual interviews. If at any time you request to withdraw from the study, the request will be granted without penalty.

What are the possible benefits from being in this study?

Research is designed to benefit society by gaining new knowledge. Sharing your experiences and methods for mathematical success may help you and your peers gain insights and understandings that are of benefit to you.. Your experiences as a successful mathematics student will inform educators and

policy-makers of the strategies and environments that foster mathematics success among African-American students

What are the possible risks or discomforts involved from being in this study?

Although there are no known risks to participating in this study, you may feel some uneasiness in describing any challenges you have faced in academic or social circles. Recounting experiences that have brought you to your current academic status may be difficult for some.

Efforts will be made by the researcher to make you as comfortable as possible. Interviews and focus groups will be conducted in an environment that is open, comfortable, and private, where you can feel secure about any emotions and experiences that are divulged to the researcher.

There may be uncommon or previously unknown risks. You should report any problems to the researcher.

How will your privacy be protected?

In an effort to maintain privacy, your name will not be used on any audio-taped interviews or focus groups. If at any time during the interview, you request that the tape be turned off, that request will be honored. I will transcribe the tapes and they will be kept in a locked drawer in my office. I will also replace the names of any school, organization and/or community you may mention with different names to protect your identity. Your teachers and peers will not know that you are participating in the study.

For the focus group, you will be asked to choose your own pseudonym. The focus group will also be audio-taped. If you do not feel comfortable with the taping, you may decline to participate in the focus group. During the focus group, you may elect not to continue with the focus group, without penalty. To protect the privacy of other participants, you must agree not to reveal anything learned from the focus group.

With your and your parent's permission, data about your academic history will be obtained from the State Educational Data Research Center. Obtaining these data will require you to provide your social security number and date of birth. Providing your social security number and date of birth on the assent form gives permission for your academic history to be released; omitting that information denies permission. You may participate in the remainder of the study regardless of your decision about releasing your academic history.

At the conclusion of the study, data will be retained and secured. All notes and records that contain your name or the names of any school, organization or community mentioned will be destroyed. They will be replaced with the pseudonym you chose as well as those created by the researcher to describe

your hometown, high school, friends, and teachers. Identifiers will be removed by late June 2006. Once successfully removed, audiotapes will be destroyed.

In addition, you will be offered a copy of the transcript of your interview and the focus group. I will be the only person in possession of interview and focus group audiotapes until they are destroyed. Audiotapes and all documents related to the study will be kept in a secured location during the study.

Will you receive anything for being in this study?

You will receive a small token, such as a USB flash drive, for taking part in this study. The inducement will be given to you at the conclusion of the focus group. If you withdraw (or are withdrawn) from the study prior to completion, the inducement will be prorated to ¼, ½, or ¾ of the value of the token and an alternate item selected (e.g. a gift card). Food and refreshments will be provided during the focus group.

What if you have questions about this study?

You have the right to ask, and have answered, any questions you may have about this research. If you have questions, or concerns, you should contact the researchers listed on the first page of this form. Dedra Eatmon, Principal Investigator, can be reached via phone, at (919) 416-2740, or email (deatmon@email.unc.edu). Carol Malloy, Ph.D., faculty advisor, can be reached via phone, at (919) 962-6607, or email (cmalloy@email.unc.edu).

What if you have questions about your rights as a research participant?

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

Participant's Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate in this research study.

Your signature if you agree to be in the study

Date

Printed name if you agree to be in the study

Social Security Number (SSN)

Date of Birth (mm/dd/yyyy)

Signature of Person Obtaining Assent

Date

Printed Name of Person Obtaining Assent

Appendix C: Adult Consent Form

**University of North Carolina-Chapel Hill
Consent to Participate in a Research Study
Adult Participants
Social Behavioral Form**

IRB Study #06-0046

Consent Form Version Date: 4 May 2006

Title of Study: Breaking All the Rules: Portraits of Mathematically Successful African-American Students

Principal Investigator: Dedra Eatmon

UNC-Chapel Hill Department: School of Education

UNC-Chapel Hill Phone number: N/A

Email Address: deatmon@email.unc.edu

Co-Investigators:

Faculty Advisor: Carol E. Malloy, Ph.D.

Funding Source: N/A

Study Contact telephone number: Dedra Eatmon, 919.416.2740

Study Contact email: deatmon@email.unc.edu

What are some general things you should know about research studies?

You are being asked to take part in a research study. To join the study is voluntary. You may refuse to join, or you may withdraw your consent to be in the study, for any reason, without penalty.

Research studies are designed to obtain new knowledge. This new information may help people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

The purpose of this research study is to learn about the academic and social experiences of mathematically successful African-American students at specialized, residential schools. The aspects of identity that will be investigated are peer group selection, academic orientation, and racial identity.

You are being asked to be in the study because you are an African-American senior at Caldwell Academy who has successfully completed Precalculus and is enrolled in Calculus or a higher level mathematics course.

How many people will take part in this study?

If you decide to be in this study, you will be one of approximately 10 people in this research study.

How long will your part in this study last?

Your participation in the study will take approximately 6 weeks. The individual participatory elements (mathematics autobiography, questionnaire, and interview) will occur over a 4-week period with a focus group of all participants approximately two weeks later. Your participation in the study should be complete by the end of May 2006.

What will happen if you take part in the study?

Once your permission is received to participate in the study, you will be asked to write a mathematics autobiography, complete a racial identity assessment, participate in an individual interview and participate in a focus group. The mathematics autobiography will take approximately one hour. It asks you to reflect on your mathematical experiences and to make comparisons between mathematics at your home school and at Caldwell Academy. The assessment will take about 15 minutes and contains items to which you will agree or disagree on a 7-point scale. Sample items include items such as “In general, being Black is an important part of my self-image” and “Being black is an important reflection of who I am.” When completing the assessment, you may choose to not respond to an item for any reason.

The interview and focus group(s) will last approximately 30-45 minutes. The interview will take place at a mutually convenient location. It will cover your mathematical and social experiences both prior to and since enrolling at Caldwell Academy. With your permission, the interview will be audio-taped and transcribed. You will have the right not to answer any question for any reason. Questions for the focus group will come from information gained during the individual interviews. If at any time you request to withdraw from the study, the request will be granted without penalty.

What are the possible benefits from being in this study?

Research is designed to benefit society by gaining new knowledge. Sharing your experiences and methods for mathematical success may help you and your peers gain insights and understandings that are of benefit to you.. Your experiences as a successful mathematics student will inform educators and policy-makers of the strategies and environments that foster mathematics success among African-American students

What are the possible risks or discomforts involved from being in this study?

Although there are no known risks to participating in this study, you may feel some

uneasiness in describing any challenges you have faced in academic or social circles. Recounting experiences that have brought you to your current academic status may be difficult for some.

Efforts will be made by the researcher to make you as comfortable as possible. Interviews and focus groups will be conducted in an environment that is open, comfortable, and private, where you can feel secure about any emotions and experiences that are divulged to the researcher.

There may be uncommon or previously unknown risks. You should report any problems to the researcher.

How will your privacy be protected?

In an effort to maintain privacy, your name will not be used on any audio-taped interviews or focus groups. If at any time during the interview, you request that the tape be turned off, that request will be honored. I will transcribe the tapes and they will be kept in a locked drawer in my office. I will also replace the names of any school, organization and/or community you may mention with different names to protect your identity. Your teachers and peers will not know that you are participating in the study.

For the focus group, you will be asked to choose your own pseudonym. The focus group will also be audio-taped. If you do not feel comfortable with the taping, you may decline to participate in the focus group. During the focus group, you may elect not to continue with the focus group, without penalty. To protect the privacy of other participants, you must agree not to reveal anything learned from the focus group.

With your permission, data about your academic history will be obtained from the State Educational Data Research Center. Obtaining these data will require you to provide your social security number and date of birth. Providing your social security number and date of birth on the assent form gives permission for your academic history to be released; omitting that information denies permission. You may participate in the remainder of the study regardless of your decision about releasing your academic history.

At the conclusion of the study, data will be retained and secured. All notes and records that contain your name or the names of any school, organization or community mentioned will be destroyed. They will be replaced with the pseudonym you chose as well as those created by the researcher to describe your hometown, high school, friends, and teachers. Identifiers will be removed by late June 2006. Once successfully removed, audiotapes will be destroyed.

In addition, you will be offered a copy of the transcript of your interview and the focus group. I will be the only person in possession of interview and focus group audiotapes until they are destroyed. Audiotapes and all documents related to the study will be kept in a secured location during the study.

Participants will not be identified in any report or publication about this study. Although every effort will be made to keep research records private, there may be times when federal or state law requires the disclosure of such records, including personal information. This is very unlikely, but if disclosure is ever required, UNC-Chapel Hill will take steps allowable by law to protect the privacy of personal information. In some cases, your information in this research study could be reviewed by representatives of the University, research sponsors, or government agencies for purposes such as quality control or safety.

Will you receive anything for being in this study?

You will receive a small token, such as a USB flash drive, for taking part in this study. The inducement will be given to you at the conclusion of the focus group. If you withdraw (or are withdrawn) from the study prior to completion, the inducement will be prorated to ¼, ½, or ¾ of the value of the token and an alternate item selected (e.g. a gift card). Food and refreshments will be provided during the focus group.

Will it cost you anything to be in this study?

There will be no costs for being in the study

What if you have questions about this study?

You have the right to ask, and have answered, any questions you may have about this research. If you have questions, or concerns, you should contact the researchers listed on the first page of this form. Dedra Eatmon, Principal Investigator, can be reached via phone, at (919) 416-2740, or email (deatmon@email.unc.edu). Carol Malloy, Ph.D., faculty advisor, can be reached via phone, at (919) 962-6607, or email (cmalloy@email.unc.edu).

What if you have questions about your rights as a research participant?

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

Participant's Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate in this research study.

Signature of Research Participant

Date

Printed Name of Research Participant

Social Security Number (SSN)

Date

Signature of Person Obtaining Consent

Date

Printed Name of Person Obtaining Consent

Appendix D: Mathematics Autobiography Protocol

1. Identify and write about significant moments you have had with mathematics from kindergarten to your current grade. Please include both positive and negative experiences. The experiences can be either in-school or out-of school.
 - a. When were you first drawn to mathematics?
 - b. What is it that drew you toward mathematics?
2. When did you first realize you were “good at math?”
 - a. Describe and elaborate on this memory.
 - b. How did you feel when you made this realization?
 - c. Who helped you realize you were “good at math?”
 - d. Do you feel the same way about your abilities now?
3. Describe the best mathematics teacher you had?
 - a. What was it like to be in this teacher’s class?
 - b. What qualities or characteristics influenced your thoughts about this teacher?
 - c. How was this teacher different from other teachers?

Appendix E: Scoring Instructions for the Multidimensional Model of Black Identity (MIBI)

Reverse score all items that have a (R) next to them by subtracting 8 from each individuals' score on the item. Next, average the scores for each of the items within a particular subscale. DO NOT CREATE A SUM SCORE FOR THE ENTIRE SCALE. Because the MIBI is based on multidimensional conceptualization of racial identity, a composite score from the entire scale is inappropriate.

CENTRALITY ITEMS (8): 1(R), 6, 9, 13 (R), 19,33,48,51 (R)

PRIVATE REGARD ITEMS (6): 4, 7, 8,24 (R), 54, 55

PUBLIC REGARD ITEMS (6): 5, 15, 17 (R), 52 (R), 53, 56

ASSIMILATION ITEMS (9): 10, 18, 37, 39, 40, 41, 43, 44, 46

HUMANIST ITEMS (9): 23, 26, 27, 28, 29, 30, 31, 32, 35

MINORITY ITEMS (9): 20, 34, 36,38,42,45,47,49,50

NATIONALIST ITEMS (9): 2, 3, 11, 12, 14, 16,21,22,25

Multidimensional Inventory of Black Identity (MIBI)

	Strongly Disagree			Neutral			Strongly Agree	
	1	2	3	4	5	6	7	
1. Overall, being Black has very little to do with how I feel about myself.	1	2	3	4	5	6	7	
2. It is important for Black people to surround their children with Black art, music and literature.	1	2	3	4	5	6	7	
3. Black people should not marry interracially.	1	2	3	4	5	6	7	
4. I feel good about Black people.	1	2	3	4	5	6	7	
5. Overall, Blacks are considered good by others.	1	2	3	4	5	6	7	
6. In general, being Black is an important part of my self-image.	1	2	3	4	5	6	7	
7. I am happy that I am Black.	1	2	3	4	5	6	7	

	Strongly Disagree			Neutral			Strongly Agree
	1	2	3	4	5	6	7
8. I feel that Blacks have made major accomplishments and advancements.	1	2	3	4	5	6	7
9. My destiny is tied to the destiny of other Black people.	1	2	3	4	5	6	7
10. Blacks who espouse separatism are as racist as White people who also espouse separatism.	1	2	3	4	5	6	7
11. Blacks would be better off if they adopted Aftocentric values.	1	2	3	4	5	6	7
12. Black students are better off going to schools that are controlled and organized by Blacks.	1	2	3	4	5	6	7
13. Being Black is unimportant to my sense of what kind of person I am.	1	2	3	4	5	6	7
14. Black people must organize themselves into a separate Black political force.	1	2	3	4	5	6	7
15. In general, others respect Black people.	1	2	3	4	5	6	7
16. Whenever possible, Blacks should buy from other Black businesses.	1	2	3	4	5	6	7
17. Most people consider Blacks, on the average, to be more ineffective than other racial groups.	1	2	3	4	5	6	7
18. A sign of progress is that Blacks are in the mainstream of America more than ever before.	1	2	3	4	5	6	7
19. I have a strong sense of belonging to Black people.	1	2	3	4	5	6	7
20. The same forces which have led to the oppression of Blacks have also led to the oppression of other groups.	1	2	3	4	5	6	7
21. A thorough knowledge of Black history is very important for Blacks today.	1	2	3	4	5	6	7
22. Blacks and Whites can never live in true harmony because of racial differences.	1	2	3	4	5	6	7

	Strongly Disagree			Neutral			Strongly Agree	
	1	2	3	4	5	6	7	
23. Black values should not be inconsistent with human values.	1	2	3	4	5	6	7	
24. I often regret that I am Black.	1	2	3	4	5	6	7	
25. White people can never be trusted where Blacks are concerned.	1	2	3	4	5	6	7	
26. Blacks should have the choice to marry interracially.	1	2	3	4	5	6	7	
27. Blacks and Whites have more commonalties than differences.	1	2	3	4	5	6	7	
28. Black people should not consider race when buying art or selecting a book to read.	1	2	3	4	5	6	7	
29. Blacks would be better off if they were more concerned with the problems facing all people than just focusing on Black issues.	1	2	3	4	5	6	7	
30. Being an individual is more important than identifying oneself as Black.	1	2	3	4	5	6	7	
31. We are all children of a higher being, therefore, we should love people of all races.	1	2	3	4	5	6	7	
32. Blacks should judge Whites as individuals and not members of the White race.	1	2	3	4	5	6	7	
33. I have a strong attachment to other Black people.	1	2	3	4	5	6	7	
34. The struggle for Black liberation in America should be closely related to the struggle of other oppressed groups.	1	2	3	4	5	6	7	
35. People regardless of their race have strengths and limitations.	1	2	3	4	5	6	7	
36. Blacks should learn about the oppression of other groups.	1	2	3	4	5	6	7	

	Strongly Disagree			Neutral			Strongly Agree	
	1	2	3	4	5	6	7	
37. Because America is predominantly white, it is important that Blacks go to White schools so that they can gain experience interacting with Whites.	1	2	3	4	5	6	7	
38. Black people should treat other oppressed people as allies.	1	2	3	4	5	6	7	
39. Blacks should strive to be full members of the American political system.	1	2	3	4	5	6	7	
40. Blacks should try to work within the system to achieve their political and economic goals.	1	2	3	4	5	6	7	
41. Blacks should strive to integrate all institutions which are segregated.	1	2	3	4	5	6	7	
42. The racism Blacks have experienced is similar to that of other minority groups.	1	2	3	4	5	6	7	
43. Blacks should feel free to interact socially with White people.	1	2	3	4	5	6	7	
44. Blacks should view themselves as being Americans first and foremost.	1	2	3	4	5	6	7	
45. There are other people who experience racial injustice and indignities similar to Black Americans.	1	2	3	4	5	6	7	
46. The plight of Blacks in America will improve only when Blacks are in important positions within the system.	1	2	3	4	5	6	7	
47. Blacks will be more successful in achieving their goals if they form coalitions with other oppressed groups.	1	2	3	4	5	6	7	
48. Being Black is an important reflection of who I am.	1	2	3	4	5	6	7	
49. Blacks should try to become friends with people from other oppressed groups.	1	2	3	4	5	6	7	

	Strongly Disagree			Neutral			Strongly Agree	
	1	2	3	4	5	6	7	
50. The dominant society devalues anything not White male oriented.	1	2	3	4	5	6	7	
51. Being Black is not a major factor in my social relationships.	1	2	3	4	5	6	7	
52. Blacks are not respected by the broader society.	1	2	3	4	5	6	7	
53. In general, other groups view Blacks in a positive manner.	1	2	3	4	5	6	7	
54. I am proud to be Black.	1	2	3	4	5	6	7	
55. I feel that the Black community has made valuable contributions to this society.	1	2	3	4	5	6	7	
56. Society views Black people as an asset.	1	2	3	4	5	6	7	

Scales and Subscales of the Multidimensional Inventory of Black Identity (MIBI)

Centrality Scale

1. Overall, being Black has very little to do with how I feel about myself. **(R)**
2. In general, being Black is an important part of my self-image.
3. My destiny is tied to the destiny of other Black people.
4. Being Black is unimportant to my sense of what kind of person I am. **(R)**
5. I have a strong sense of belonging to Black people.
6. I have a strong attachment to other Black people.
7. Being Black is an important reflection of who I am.
8. Being Black is not a major factor in my social relationships. **(R)**

Regard Scale

Private Regard Subscale

1. I feel good about Black people.
2. I am happy that I am Black.
3. I feel that Blacks have made major accomplishments and advancements.
4. I often regret that I am Black. **(R)**
5. I am proud to be Black.
6. I feel that the Black community has made valuable contributions to this society

Public Regard Subscale

1. Overall, Blacks are considered good by others.
2. In general, others respect Black people.
3. Most people consider Blacks, on the average, to be more ineffective than other racial groups. **(R)**
4. Blacks are not respected by the broader society. **(R)**
5. In general, other groups view Blacks in a positive manner.
6. Society views Black people as an asset.

(R) items should be reverse coded

Ideology Scale

Assimilation Subscale

1. Blacks who espouse separatism are as racist as White people who also espouse separatism.
2. A sign of progress is that Blacks are in the mainstream of America more than ever before.
3. Because America is predominantly white, it is important that Blacks go to White schools so that they can gain experience interacting with Whites.
4. Blacks should strive to be full members of the American political system.
5. Blacks should try to work within the system to achieve their political and economic goals.
6. Blacks should strive to integrate all institutions which are segregated.
7. Blacks should feel free to interact socially with White people.
8. Blacks should view themselves as being Americans first and foremost.
9. The plight of Blacks in America will improve only when Blacks are in important positions within the system.

Humanist Subscale

1. Black values should not be inconsistent with human values.
2. Blacks should have the choice to marry interracially.
3. Blacks and Whites have more commonalities than differences.
4. Black people should not consider race when buying art or selecting a book to read.
5. Blacks would be better off if they were more concerned with the problems facing all people than just focusing on Black issues.
6. Being an individual is more important than identifying oneself as Black.
7. We are all children of a higher being, therefore, we should love people of all races.
8. Blacks should judge Whites as individuals and not as members of the White race
9. People regardless of their race have strengths and limitations.

Ideology Scale (Continued)

Oppressed Minority Subscale

1. The same forces which have led to the oppression of Blacks have also led to the oppression of other groups.
2. The- struggle for Black liberation in America should be closely related to the struggle of other oppressed groups.
3. Blacks should learn about the oppression of other groups.
4. Black people should treat other oppressed people as allies.
5. The racism Blacks have experienced is similar to that of other minority groups.
6. There are other people who experience racial injustice and indignities similar to Black Americans.
7. Blacks will be more successful in achieving their goals if they form coalitions with other oppressed groups.
8. Blacks should try to become friends with people from other oppressed groups.
9. The dominant society devalues anything not White male oriented.

Nationalist Subscale

1. It is important for Black people to surround their children with Black art, music and literature.
2. Black people should not marry interracially.
3. Blacks would be better off if they adopted Afrocentric values.
4. Black students are better off going to schools that are controlled and organized by Blacks.
5. Black people must organize themselves into a separate Black political force.
6. Whenever possible, Blacks should buy from other Black businesses.
7. A thorough knowledge of Black history is very important for Blacks today.
8. Blacks and Whites can never live in true harmony because of racial differences.
9. White people can never be trusted where Blacks are concerned.

Appendix F: Individual Interview Protocol

Academic

1. Why did you choose to apply and come to this school?
2. What mathematics course(s) did you take your junior year?
3. What mathematics course(s) are you enrolled in this year?
4. What do you like about mathematics? What do you dislike about mathematics?
5. Describe your mathematics ability.
6. Describe your feelings about mathematics at your home school.
7. Describe your feelings about mathematics at Caldwell Academy?
8. What characteristics make a good mathematics student?
9. According to your definition, what type of mathematics student are you?
10. How do you study for mathematics? Talk about your mathematics study habits. In addition to a. and b. prompt for study alone, groups, teacher help if they do not mention these things
 - a. How often do you study?
 - b. What percentage/portion of studying do you do primarily alone?
 - c. How often do you study mathematics with your friends?
 - d. How often do you get assistance from your teacher or other teachers in the mathematics department?
11. Describe your study habits at your home school.
12. Describe your study habits since attending Caldwell Academy.
13. What type of student did you perceive yourself to be at your home school?
14. What type of student do you perceive yourself to be at Caldwell Academy?
15. On a scale of 1 – 10, how would you rate your mathematics performance at your home school? At Caldwell Academy?
16. On a scale of 1- 10, how would you rate the effort you put into mathematics at your home school? At Caldwell Academy?
17. Do you perform to your ability in mathematics? Why or why not? Talk about how your performance is or is not related to your ability.
18. Of the following mathematics courses, which ones do you think you could take and pass?
 - a. Geometry
 - b. Finite
 - c. Discrete mathematics
 - d. Calculus
 - e. Fractals and Chaos
 - f. Combinatorics
 - g. Mathematical Modeling
 - h. Problem Solving
 - i. Number Theory
 - j. Graph Theory
19. What are your future academic and career plans?
20. How relevant is mathematics to your future plans?

Social/Cultural

*Students will be asked to fill out racial assessment prior to the interview.

Assessments

Racial Identity

a. Multidimensional Inventory of Black Identity (Sellers)*

1. What was the approximate racial composition at your home school?
2. What type of peer/social group did you have at your home school?
3. Describe any differences between your school peer group and your home peer group in your hometown.
4. What types of similarities or characteristics draw you to others?
5. Describe your peer group at Caldwell Academy. What things (characteristics or interests) do you share with your peer group?
6. Describe the members of your study group(s). What things do you share with your study group?
7. What types of characteristics or interests do you share with your friends (peer group)?
8. Talk about your experiences at your home school and Caldwell Academy.
9. What factors affect your school and mathematics experiences? (Prompt for race if is not mentioned.)

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