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Under Construction: Conceptualizations of Mathematics Competence

and Mathematics Self-Concept of a Group of African American Adolescent Students

by

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An abstract of

A dissertation submitted to the Faculty of the

James T. Laney School of Graduate Studies of Emory University

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Abstract

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This study explored the constructions of mathematical competence of six African American adolescent students who participated in a 2011 summer academic enrichment program in an urban setting in the Southeast. The study used a multiple case study design to address the following research questions:

1. What mathematical competence beliefs are held by a sample of adolescent African American students?
2. What mathematics self-concept beliefs are held by a sample of adolescent African American students?
3. In what ways do these students reveal that they construct these mathematics competence and self-concept beliefs?

The multiple case study incorporated interviews with student participants and their parents. Although this research was designed as a qualitative exploration, it supplemented interviews with data collected from administrations of various instruments (e.g., SDQ-II, MIBI-t) and student-generated documents in order to further explore aspects of students' mathematics self-concept and racial identity, respectively, along with their mathematics identity and mathematics socialization.

Findings suggest that participants' beliefs about what comprises competence in mathematics can be compared to Skemp's (1976) notion of relational understanding and to the five strands of Kilpatrick, Swafford, and Findell's (2001) concept of mathematical proficiency. Although every participant identified as a "student" or learner and several incorporated descriptions of intelligence in their self-descriptions, none identified in a way that was explicitly or exclusively *mathematical*—despite differing in levels of achievement, interest, and engagement. Students who exhibited the strongest mathematics self-concept beliefs tended to demonstrate the greatest stability in these beliefs during the period of the study. Participants noted that they were influenced by interactions with particular significant others, including teachers, parents, and peers. Students emphasized that their perceptions of teacher care often facilitated their openness to engage and persist in mathematics. Also, participants indicated that they engaged in constructing their mathematics competence and self-concept beliefs by evaluating the degrees of congruence in their classification of mathematics as a discipline, and their characterizations of themselves as individuals. Although participants who took the MIBI-t expressed high private regard for being African American, they uniformly acknowledged believing that other groups viewed the intelligence of African Americans with relatively low regard.

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Acknowledgements

"For I know the plans I have to prosper you," declares the Lord, "plans to prosper you and not to harm you, plans to give you hope and a future." Jeremiah 29:11 (NIV)

He determined the times set for them and the exact places where they should live. God did this so that men would seek Him and find Him, though He is not far from us. Acts 17:26b-28 (NIV)

I begin these acknowledgements with the recognition of the sovereignty of God, who has both set in motion a plan for my life and has empowered me to take steps that bring me closer to Him, as His plan unfolds. Even when I failed to recognize His presence, and was blind to His plans, He sustained me at Emory University and enabled me to complete this dissertation with generous love and abundant support from family and friends.

The love of my biological family has been among the most powerfully sustaining elements during my time at Emory. I am indebted to my family in ways that I cannot in a lifetime repay. I have come to rely on the unfailing and persistent love of my mother, Ruth Blanding, whose unwavering faith in my ability strengthens me. I always count on my cousin/sister Teresa Thurmond and her mother, Naomi Evans, for encouragement. Teresa's husband, Carl, provides an admirable professional and personal example of diligence and focused study, and has consistently encouraged my efforts toward the same. My aunt, Patricia Adams, has also always made it a point to support my academic dreams and endeavors.

The joy of contemplating these acknowledgements is tempered by the lost of close family members who are unable to celebrate the completion of this degree. Among the family members are my maternal grandparents, James ("PaPa") and Adeline McGhaney ("NaNa"), in whose loving home I came to know and appreciate what "family" is. I mourn the losses of my father, James E. Goings, and my paternal grandfather, James Goings, whose gentle exhortations I felt no less significantly. I also acknowledge the contributions of my eldest cousin, Beverly "Jean" Montgomery, who helped me at our grandparents' house as early as when I was in the first grade.

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Chapter One:
INTRODUCTION

The history of educational assessment in the United States and contemporary inclinations towards heightened accountability contribute to a discourse that often indicts the very students these initiatives aim to serve. The launch of Sputnik in 1957 helped to intensify American attention to mathematics and science education in an effort to make our nation more technologically competitive on a global scale. A dramatic decline in Scholastic Aptitude Test (SAT) scores between 1967 and 1982 signaled the educational community that the American education was in peril. Indeed, the document *A Nation at Risk* (Denning, 1983), commissioned by then-Secretary Terrel Bell, confirmed the crisis anticipated by declining SAT scores. In addition to arguing for more challenging tests, *A Nation at Risk* pushed the nation towards greater accountability and raised educational issues higher on state agendas. *Everybody Counts* (NRC, 1989) echoed the call of *A Nation at Risk* for greater mathematics achievement for all students, not just the most talented. These documents were instrumental in drawing attention not only to the gap in U.S. mathematics achievement and that of other nations, but also to the disparagingly low numbers of students of color who were achieving in mathematics (Nasir, Hand & Taylor, 2008).

The relative underperformance of African American students was and remains consistently documented in the National Assessment of Educational Progress (NAEP) data. Upon its implementation in the late 1960s, NAEP has been administered to a random sample of students at ages 9, 13, and 17. At the elementary level, the assessment performance scores are based on a nationally representative sample of almost 169,000 fourth-graders. The national results are disaggregated by ethnic group, region, and community size.

The data documenting differences in performances across races remain alarming. Since 2007, there has been no significant change in the performance of racial/ethnic groups including, but not limited to African Americans. The gap in scale scores between African American and White eighth grade mathematics students in 2013 was reported as 31 points. This gap, however, is only slightly narrower than the 33-point gap present in 1990 (National Center for Educational Statistics, 2013).

As Giroux, Lankshear, McLaren, and Peters (Martin, 2007) attest, these results, along with others, have been influential in establishing, maintaining, and disseminating a masternarrative that is used to position students of color, especially African American students, as mathematically incompetent—or worse, incapable. Local curricula have been designed and state and national reforms have been initiated to address the persistent issue of underperformance. Many of the initiatives are coupled with calls for higher standards and better mathematics instruction (Nasir, Taylor, & Hand, 2007). Despite even the best intentions of a number of these initiatives, African American students continue to perform poorly in school mathematics (Ladson-Billings, 1997).

Even though they often start with noble intentions, some initiatives are more short-sided than others. For example, the Virginia State Board of Education has proposed the following new racially stratified mathematics passing rate: 82%, for Asian students; 68%, for Whites; 52% for Latinos: 45%, for Blacks; and 33%, for disabled students (Sanchez, November 12, 2012). Patricia Wright, the state superintendent of public instruction, argues that the new policy is an attempt to address "the reality that black and Latino children generally don't do as well," by "setting more modest goals for struggling minority students and giving them more time to catch up." Although these policymakers probably want African American and other students to achieve academically, their initiatives fail to interrogate the source of disparate achievement scores and academic performances. Also, these initiatives perpetuate various narrative about multiple subgroups—complimentary and encouraging to particular group; pejorative and disruptive to others.

Unfortunately, the narratives in which stakeholders participate are not without effect or consequence. Flores (2007) asks what kinds of images we form about students who lag behind after we hear, often repeatedly, the discourses of deficiency. He charges us to examine the assumptions we make about their capacity for learning and insists that we interrogate the reasons their performance is worse. Superficial examination of symptoms of underachievement can lead to a misdiagnosis. Such cursory reviews can also result in an exclusive focus on student characteristics as the cause. McLoyd (1991, p. 425) posits that such analyses tend to …

> Study African Americans in terms of how they differ from European Americans … (a) point to the ways in which African

> American children do not behave rather than how they do behave, yielding data that are limited in their informative value, virtually useless in generating theory and ultimately, capable of supporting only superficial analyses of individual differences and their determinants among African Americans…and (b) foster indirectly the views that African American children are abnormal, incompetent, and changeworthy since differences between African Americans and European American children are typically interpreted, if not by the author, by a significant portion of the readers, as deficiencies or pathologies in the former rather in cultural relativistic or systemic terms .

McCloyd further critiques the restricted nature of information produced through this race-comparative paradigm. Song (2004) emphasizes that it has become "politically and intellectually acceptable to compare and assess the nature and intensity of group experiences" (p. 863). She also highlights the existence of a racial hierarchy "explicit or implicit in most American scholarship … in which African Americans are at the bottom" (p. 863). Although the plurality of experiences of multiple cultural groups may naturally suggest racially comparative paradigms, these strategies and methodologies should be utilized thoughtfully, with careful attention to the conclusions that can mistakenly be drawn prematurely and with serious consequences.For example, much of the standardized test and achievement data ends up being used to pathologize African American and other students who perform poorly on high-stakes, although the real message that standardized mathematics assessments, achievement data and persistence trends confirm is that not all students experience mathematics equitably. Moreover, Martin (2006) asserts that "mathematical learning, participation, and the struggle for mathematics literacy [can] be conceptualized as racialized forms of experience—that is, as experiences where race and the meanings constructed around race become highly salient" (p.

198). The nature and salience of these racialized experiences are often lost—or not attended to—in politicized discussions of mathematics achievement.

To some degree, the notion that experiences in mathematics are racialized is reflected in Steele's (2010) notion of "identity contingencies." Identity contingencies are "circumstances you have to deal with in a situation because you have a given social identity, because you are old, young, gay, a white male, a woman, [or] black" (p. 3). These social (and racial) identities, Steele maintains, still influence distributions in societal outcomes. For example, Steele (1997) posits that the salience of race and racial stereotypes can be enough to depress the academic performance of some African American students. In other words, knowledge of the negative stereotype of African American [in]ability in mathematical domains can threaten the academic performance of African American students. Steele contemplates conditions that have imperiled African American achievement, insisting that our concerns expand beyond lack of aptitude as the sole explanation of underperformance in mathematics.

Thus, the portrait communicated almost exclusively through a heightened attention to standardized test data is often incomplete. Raw achievement data may be a necessary component of the narrative—especially within the climate of *No Child Left Behind*—but they are not sufficient. Although these data are communicative, educators, researchers and policymakers should be cautious in their interpretations and implications. *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989) suggests that assessing students' beliefs about mathematics is an important component of the overall assessment of mathematical knowledge (Spangler, 1992). It recommends not only that educators are expected to be aware of students' mathematical beliefs, but also that considerable importance can be attributed to students' awareness of their own beliefs toward mathematics.

Missing from much of the discourse surrounding achievement scores of minority mathematics students is discussion regarding how these students conceptualize beliefs about mathematical competence and, more precisely, what their conceptualizations are. These kinds of discussions are particularly important in the case of African American students whose scores remain at the lowest position among minority performances. Districts and states continue to explore and experiment with mandates and initiatives intended to facilitate an increase in the test scores of African Americans and other populations in the critical area of mathematics but without the critical knowledge to inform these initiatives. Since *No Child Left Behind* (NCLB) requires annual testing for students in grades three through eight, it seems essential to understand the mathematical competence beliefs held by these young students when interpreting these achievement data. But currently, although the National Assessment of Educational Progress (NAEP) includes the evaluation of the mathematical competence of third graders as constructed by the instrument developers, there is no national assessment of the constructions of mathematical competence beliefs of these young students. In order to give the disparity in races in standardized mathematics test scores the careful attention it merits, it becomes important to consider the constructions of mathematical competence of African American students allowing attention to the manner in which they construct them.

Although the refrain of the underachievement of African American students is frequently repeated, Cokley, Komarraju, King, Cuningham, and Muhammad (2003) suggest that "a thorough understanding of their academic self-concept may shed insight into this phenomenon" (p. 720). As Usher (2009, p. 278) maintains, qualitative inquiry can provide a nuanced understanding of how self beliefs are generated and developed by uncovering the "heuristic techniques" young students use to evaluate their academic competence. Attending to the voices of African American adolescent students who are able to reflect thoughtfully and communicate effectively about their learning has the potential to provide insights into the multiple mechanisms students employ to construct their conceptualizations of mathematics competence and mathematics self-concept.

Significance

The allure of standards-based reform is that it represents a public commitment that schools ought to ensure that all children be taught a discrete body of knowledge and skills to a specified level of mastery (Hess, 2003). The dynamics of accountability require officials to make a number of politically sensitive decisions which include the notion that assessments must be administered to render clear indications as to whether students have or have not mastered requisite skills and content (West & Peterson, 2003). A preliminary consideration, however, is the determination of *what* mastery represents.

In the subject of school mathematics, the National Council of Teachers of Mathematics (NCTM), as a national organization, has taken on the primary responsibility of providing educators with general guidelines and suggestions for recognizing competence and mastery. The NCTM provides a model for other professional organizations intent upon establishing domain standards and promoting reform in mathematics classrooms. As one example, the *Curriculum and Evaluation Standards for School Mathematics*, NCTM (1989) asserts that students' beliefs "exert a powerful influence on students' evaluation of their own ability, on their willingness to engage in mathematical tasks, and on their ultimate mathematical disposition" (p. 233).

Nevertheless, over the last 25 years of mathematics reform, the gaps in achievement between African American and White students have not diminished significantly. Ladson-Billings (1997) reports that African American students continue to underperform in mathematics. And Flores (2007) notes that gaps in mathematics achievement have not closed significantly in the last three decades.

Battista (1999) maintains that traditional teaching continues to take its toll on the nation and on individuals:

> Although almost all commercially available mathematics textbooks claim to be consistent with the NCTM Standards most of these textbooks consist of traditional curricula with enough superficial changes tacked on so that publishing companies can market them as "new" and consistent with reform.

Consequently, the mathematics that most children experience in school more often than not focuses on repetition, drill, convergent, right-answer thinking, and predictability. Pellegrini and Stanic (1993) argue that the nature of school and standardized math tasks, and the manner in which it is taught seem to be or little use and value to many segments of American society. Also problematic for students of color is that school mathematics curricula, assessment, and pedagogy are often closely aligned with an idealized cultural experience of the White middle class (Berry, 2003; Ladson-Billings, 1997; Pellegrini & Stanic, 1993). This mis-alignment risks positioning significant numbers of African American mathematics students at a disadvantage.In summary, neither the alignment of mathematics curricula, assessment, and pedagogy nor the optimistic reform they purport to reflect takes into account the mathematical competence beliefs that African American students hold.

The manner in which African American students construct mathematical competence may provide insight into how, and if, these students [dis]identify with mathematics. Better-nuanced understandings of these mechanisms could illuminate strategies, pedagogies, and activities with improved likelihood of contributing to a more comprehensive conceptual understanding of mathematics for larger numbers of African American students.

Purpose

The purpose of this study is to explore the constructions of mathematical competence of a group of African American adolescent students in an urban setting in the Southeast. This examination focuses not only on *what* their mathematics competence constructions are, appear to be, and are expressed to be, but also on the influences of these students' experiences with mathematics, and affective components of these experiences, on their constructions of math competence.

Research Questions

This study explores the following research questions:

1. What mathematical competence beliefs are held by a sample of adolescent African American students?
2. What mathematics self-concept beliefs are held by a sample of adolescent African American students?
3. In what ways do these students reveal that they construct these math competence and self-concept beliefs?

Conceptual Framework

During the last thirty years, there has been a "social turn" in mathematics education research (Lerman, 2000). Attention has begun to broaden to consider sociocultural theory, cultural-historical activity theory, social cognitive theory, and constructivist theories. In this shift, scholars now elevate the social component of learning experiences, including the cultural and historical influences that shape student experiences. The conceptual frames for this study adopt components from a number of traditions and previous studies to examine the mathematical experiences of African American students—or more specifically their experiences *as* African American students in mathematics classrooms (Martin & McGee, 2009). Details of the primary conceptual framework used in this study follow.

Danny Martin's Multilevel Framework for Analyzing Math Identity and Socialization. Martin (2000) recommends focusing attention on the constructs of mathematics identity and mathematical socialization as appropriate theoretical and methodological tools in empirical studies involving students' mathematical behaviors and contextual factors. He uses the phrase "mathematics identity" to refer to "participants' beliefs about (a) their ability to perform in mathematical contexts, (b) the instrumental importance of mathematical knowledge, (c) constraints and opportunities in mathematical contexts, and (d) the resulting motivations and strategies used to obtain mathematical knowledge" (p. 19). Martin offers the expression "mathematical socialization" to describe "the processes and experiences by which individual and collective identities are shaped by sociohistorical, community, school, and intrapersonal contexts" (p. 19).

Martin argues that a focus on mathematics socialization and identity are useful for a number of reasons. The notion of socialization allows for researchers to account for sociohistorical and contemporary experiences of African Americans. Attention to socialization also highlights the roles and activities of community, family, and school members. A focus on identity considers how participants define what it means to be African American in the context of learning mathematics and what it means to learn mathematics in the context of being African American.

To assist in the analysis of these issues, Martin (2000) has developed a multilevel model of the sources of influences on African American identity and socialization within the context of mathematics education. These influences contribute to an individual's development of a sense of mathematical competence. The sociohistorical is the all-encompassing level of Martin's framework. This level "refers to the historically based discriminatory policies and practices that have prevented African Americans from becoming equal participants in mathematics and other areas of society" (Martin, 2000, p. 29). For example, it is on this level that

Martin considers the differential treatment that many African American students encounter in mathematics–related contexts. Importantly, this level facilitates interpretation of macro-level structural influences on students' conceptualizations of mathematical competence.

At the community level, Martin elaborates cultural and community beliefs about mathematics, mathematics abilities and motivations to learn mathematics. He also highlights beliefs about African American status and about the importance of mathematics knowledge. Among the community themes are educational goals and expectations for children. This level incorporates understandings of relationships that students, their parents, and the community have with school officials. It is possible for students to access these relationships as they form their mathematical competence and their beliefs about it.

The third level addresses school-level factors. Martin (2000) delineates the primary focus as "the negotiation of mathematical and social norms that occur in African-American students' classrooms" (p. 31), that is, within the classrooms that African American students inhabit whether segregated or integrated. This negotiation incorporates teachers' beliefs about student abilities and motivation. It also emphasizes teacher and institutional curricular goals and practices. Other school-level factors include the dominant student culture and achievement norms.

The final level of the framework focuses on individual agency and mathematics success among African American students. This particular focus highlights strength, resilience, and agency in African American students who have navigated contextual factors to achieve success in spite of, or in light of, these factors (Martin, 2000).

Martin points out that investigations at this level interrogate a number of the typical assumptions concerning African Americans, African American students, and how they respond to these contextual forces. Key themes at this level include personal identities and goals, along with individual perceptions about school culture and its multiple components. Other themes at this level consider the student beliefs about mathematics abilities and motivation, the importance of mathematical knowledge, and differential peer treatment.

A number of studies address one of these contexts. In some cases, Martin posits, studies simplify relationships between them in order to facilitate analysis.

Figure 1 graphically represents a schema of the multiple levels of Martin's analysis, taking into account individual agency and mathematics socialization.

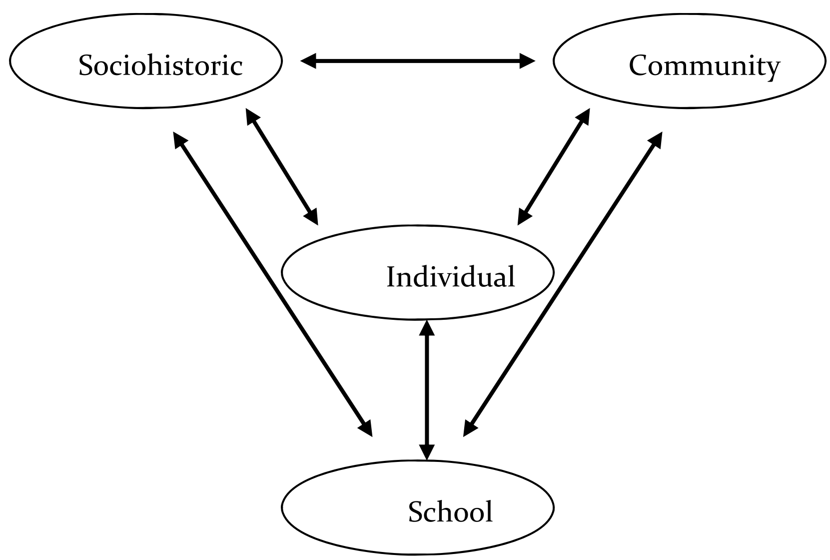

Figure 1. Martin's framework incorporating individual agency and socialization

It includes notions of mathematics socializations and identity formation, which "occur as an individual negotiates the contextual forces, opportunities, and constraints that he or she encounters and that come to bear on that individual's mathematical development" (Martin, 2000, p. 33). This representation is explicit in depicting the non-linearity of these relationships while also incorporating contributions of personal agency.

Chapter Two:
LITERATURE REVIEW

This literature review is organized into four major sections. First, the review introduces prevalent conceptualizations of mathematical competence. The next section surveys scholarship on student beliefs about mathematics in general. The third section describes student attitudes regarding mathematical competence. Information that references the experiences and beliefs of African American students regarding school mathematics and mathematical competence will be highlighted. A final section organizes theoretical and empirical studies of self-concept construct. This concluding section distinguishes self-concept from other motivational constructs and highlights literature that attends to the relationship between race/ethnicity and (academic/mathematical) self-concept.

Literature for this review was initially identified by conducting searches using ERIC (EBSCO Host), JSTOR, and Google Scholar databases. My preliminary searches yielded substantial information in the affective domains of education, including attitudes, goals, and motivation. However, I expanded my search to include PsycINFO, PsychARTICLES, and PyschEXTRA) to address even more psychological elements. And as my research reflects a "social turn in mathematics education," (Lerman, 2000, p. 19) I broadened my search to attend to attend to the social dimensions of education and, subsequently, incorporated the Sociological Abstracts database.

Among the terms used in each database search were the following: "mathematical competence," "mathematics beliefs," "mathematics attitudes," and "self-concept." Search results dwindled considerably as I added "African American" to any of these phrases. These search results identified articles and others texts to whose bibliographies I referred in order to locate other references.

Prevalent Conceptualizations of Mathematics Competence

Since the heightened accountability of No Child Left Behind (NCLB) focuses attention on state and national tests, it intensifies the need to consider students' beliefs about mathematics and alternative definitions of mathematical competence. Many of the standardized tests that are utilized purport to assess mathematics proficiency. The Child Trends Data Bank narrowly defines mathematical proficiency as performance on the main and long-term assessments of the National Assessment of Educational Progress (NAEP). Abrantes (2001), however, advances a broader conceptualization invoking Perrenoud's distinction between competence and performance. He relates competence to the ability to effectively activate resources such as knowledge, skills, and strategies in a variety of problematic situations. Competence, he cautions, should not be confused with specific behavior which, more accurately, characterize performance.

Gresalfi, Martin, Hand, and Greeno (2009) problematize the assumption that competence refers to the skills and abilities attributed to individuals irrespective of their specific contexts. Instead, they propose "a concept of competence as an attribute of participation in an activity system such as a classroom" (p. 50). They further redefine competence for their purposes as "what students need to know or do to be considered successful by the teacher and other students in the classroom"

(p. 50). Therefore, from this perspective, competence comes to incorporate elements of participation and is co-constructed.

Kilpatrick, Swafford, and Findell (2001) use the phrase "mathematical proficiency" to describe what they believe it means for anyone to learn mathematics successfully. They maintain that mathematical proficiency involves five interwoven strands: understanding, computing, applying, reasoning, and engaging. Understanding refers to comprehending mathematical concepts and operations. Computing refers to demonstrating fluency in carrying out mathematical procedures accurately and appropriately. Applying pertains to the ability to formulate problems mathematically and to strategically devise approaches and methods to solve problems. Reasoning deals with the adaptive use of logic to explain or justify the solution to a problem or to extend from the known to the unknown. Engaging and productive disposition describes seeing mathematics as sensible, practical, and accessible.

Skemp (2006) differentiates between two main types of understanding: instrumental understanding and relational understanding. He describes instrumental understanding simply as "rules without reasons" (p. 89). Skemp distinguishes instrumental understanding as "knowing both what to do and why" (p. 89). So, in some ways, Skemp extends Kilpatrick et al's notion of understanding as evidence of various levels of mathematics proficiency. However, while Skemp's concept of instrumental understanding might be associated with understanding and computing strands of mathematical proficiency, his notion of relational understanding supports more closely the Kilpatrick et al's strands in applying and reasoning.

At the international level, the Programme for International Student Assessment (PISA) states that mathematical literacy or competence "deals with the capacity of students (at the end of their compulsory schooling) to analyse, reason and communicate efficiently as they pose, formulate, solve and interpret mathematical problems in a variety of situations" (Saenz, 2009, p. 124). Saenz (2009) explains that the competencies that PISA evaluates can be described as those cognitive processes which students activate both, in connecting the world in which the problems arise with mathematics, and in solving the problem. PISA examines seven specific competencies to assess overall competence of students: thinking and reasoning, argumentation, communication, modeling, problem posing and solving, representation, and using symbolic, formal and technical language and operations.

Student Beliefs about Mathematics

A number of studies have focused on how students think and talk about mathematics. One of the most critical studies, by Haladyna and Thomas (1979) investigated the conceptions of elementary students. The researchers asserted that although measures of school achievement have an extensive history, "the systematic measurement of student attitudes toward school and various subject matters comprising its curriculum has been conspicuously infrequent" (p. 18). Despite this development, they cite a number of reasons to consider these attitudes. Among them is the support that educators and psychologists have garnered for affective education and attitude and their role in future learning. The authors also cite research that suggests a small positive relationship between attitude toward mathematics and mathematics achievement.

Haladyna and Thomas (1979) studied the attitudes of elementary school children toward school and subject matters. Each scale, including the one investigating mathematics attitudes, was based on responses to five questions. Responses options to items were happy, neutral, and sad faces. A total of 2845 Oregon students were administered the inventory. The researchers found that attitudes towards mathematics are relatively stable across elementary grades. Interestingly, an examination of gender differences in their study reflected that girls scored slightly higher than boys in the area of attitudes toward mathematics. This was the case in middle as well as elementary school.

The study conducted by Stodolsky, Salk, and Glaessner (1991) sheds further light on student attitudes toward mathematics. They examined student views about learning mathematics and social studies. Over a two-year period, they interviewed sixty fifth-grade pupils from upper-working to upper-middle socioeconomic backgrounds attending schools in a metropolitan area of a large Midwestern city. The sample included a broad cross section of students from both public and private, however, the authors were considerably less forthcoming about their sample's racial/cultural distribution.

The research of Stodolsky et al. is distinctive in its comparative subject matter focus. A second component of their contribution lies is fact that it examines a broad cross section of students from both public and private schools. However descriptive the authors were in regards to socioeconomic classes, they were considerably less forthcoming about their sample's racial/cultural distribution. Third, unlike many studies, which analyze data by school or classroom, the researchers in this study aggregated data by school subject.

Stodolsky et al. (1991) collected data on what students consider mathematics to be and when they liked/disliked the subject. They reported that "the majority of pupils defined math in terms of the basic arithmetic operations and as dealing with numbers" (p. 96). Pupils conceived mathematics to be a subject with particularly unchangeable content and students appeared to like mathematics when it was easy for them. They also liked mathematics when they were engaged in activities they characterized as fun. The researchers found that the "times students disliked math were overwhelmingly marked by feelings of difficulty, failure, frustration, and anxiety" (pp. 102-103).

Kloosterman and Cougan (1994) also considered the attitudes of elementary student and mathematics achievement. They examined, however, a broader range of students in grades 1-6 in an elementary school where teachers participated in a project to improve mathematics teaching. The authors chose five categories to examine. The first investigated whether students liked school and mathematics; the second, whether their parents supported school and mathematics; the third, whether they were confident in their mathematical abilities; the fourth, whether they felt that mathematics was useful; and finally, whether they believed that all children could learn mathematics.

As the project lasted for two years, Kloosterman and Cougan (1994) were also able to determine age-related trends in students' beliefs. First and second graders gave answers that were fairly brief. The researchers observed that "by third grade, students were able to verbalize responses to most questions fairly well. In grades 4-6, students generally had opinions and were able to express them" (p. 380). They also noted that most young elementary students drew their opinions from observed work habits rather than achievement in ranking their peers. First-grade students indicated that "not everyone can learn mathematics, because some students do not try" (p. 384). By third grade, however, a number of these students subscribed to the claim that all children can learn mathematics.

Kloosterman and Cougan (1994) included a couple of interesting methodological variations. They added seven mathematics problems for their students to solve during the interview. The alternated between mathematical problems and interview questions to help maintain student interest. These problems highlighted conceptual understanding of mathematics and provided a basis for comparison with achievement data which are, in some ways, institutionalized assessments of competence. A final phase of the interview asked students to categorize the nature of a set of 10 story problems as either "mathematical" or "nonmathematical." This component of the interview illuminated students' conceptualizations of mathematics.

One of the most salient studies for this review was conducted by Franke and Carey (1997). Unlike previously named studies, this research includes a sample of both African American and White students. The focus of their study, like

Kloosterman and Cougan (1994) and a number of their predecessors, was on understanding young children's perceptions of mathematics in problem-solving environments. They interviewed thirty-six first grade students from two different school systems to determine their stated perceptions of what it means to engage in mathematics. The participants came from sic classrooms; three from Madison, Wisconsin, and three from Prince Georges County, Maryland a Midwestern city with a predominately White, middle-class population,

The component of the study that locates students in two different school systems is significant. The participants came from six classrooms. Three of the classrooms were in Madison, Wisconsin. The other three classrooms were in Prince Georges County, Maryland. Madison is a Midwestern city with a predominately White, middle-class population; Prince Georges County, an urban district with a predominately African American population.

Unlike the Kloosterman and Cougan (1994) study, which found that first grade students had difficulty expressing their responses, Franke and Carey found these first-graders to be "quite open and articulate in their responses, often providing great detail" (p. 13). This could be attributed to the fact that these students were in schools that had adopted a number of reforms measures and pedagogical dispositions aligned with nontraditional methods of instruction and classroom interaction.

Other student responses reflected the school alignment with Cognitively Guided Instruction and reform initiatives. Although it is not surprising that Franke and Carey found that almost 80% of children talked about solving problems in their description of “doing math,” the students mentioned both word problems and non-word problems. Nearly 40% mentioned communication as part of doing mathematics. The researchers found more similarities than differences across sites in students’ descriptions of doing mathematics.

When the first graders were asked how they determined mathematical success, 44% mentioned correct answers while 14% mentioned speed and accuracy. Yet only about 25% referred exclusively to correct answers or speed and accuracy as determinant of mathematical success. Half of the children reported the problems that students solve and/or the strategies they employ to solve them as determining mathematical success. These statistics lend optimism to reform efforts to expand students’ understanding of what it means to “do” mathematics.

A closer look at the individual sites reveals more nuanced interpretations. Franke and Carey (1997) state that “all but one of the children who talked exclusively about correct answers and speed and accuracy were from the MD [Maryland] site” (p. 16). Children from the Wisconsin site where CGI had been implemented considered problems solved along with their strategies as determining mathematical success.

Franke and Carey (1997) elected to interview children in Cognitively Guided Instruction (CGI) classrooms. These classrooms “reflected the spirit of the current reform movement in mathematics education” (p. 8). In other words, they incorporate elements of recommendations by the National Council of Teachers of Mathematics including students “making conjectures, abstracting mathematical properties, explaining their reasoning, validating their assertions, and discussing and questioning their own thinking and the thinking of others" (p. 8). But the students from Prince Georges County were not similarly interviewed, potentially masking the variety of perceptions that might be articulated in classrooms that have been less faithful to reform efforts.

Results suggests a majority of elementary students seem to conceptualize mathematics as a subject that focuses on operations and procedures but also reveal that children in classrooms that adopt more reform-oriented instructional curricula often express broader understanding of the discipline. Unfortunately, a number of the studies neglect details of participant race. During the elementary years, these attitudes appear to be relatively stable if students are taught in traditional classrooms, though there may be some gender differences in student perceptions of mathematics and their ability to perform at it.

Student Perceptions of Mathematical Competence

Pajares and Graham (1999) studied the influence of motivational variables on the mathematics performance of students during their first year of middle school. They employ the construct of self-efficacy from Bandura's social cognitive theory. They describe self-efficacy beliefs as "judgments of confidence to perform academic tasks or succeed in activities (124). The researchers conducted multiple regression analyses to determine that students' self-efficacy was the only motivational construct to predict mathematical performance at both the start and end of the sixth grade year. Chen's (2006) results were consistent with these findings. Her study looked at the judgments of four seventh grade mathematics teachers and those of their 107 students. As she examined how students' self-assessment of their mathematical capabilities related to their teachers' judgments of student capabilities, Chen confirmed that students' mathematical self-efficacy beliefs highly predicted their performance.

Hodge (2008) suggested that as students assessed their mathematics capabilities, they also considered their roles as students and their participation. Hodge emphasized the shifting student roles that accompany recent reform recommendations. Most salient in Hodge's article, however, is the prominence of student experiences in the two classrooms organized in contrasting ways. These ways include inquiry-based (reform-oriented) and "typical" (traditional). She focuses on how students experience and express their identity and competence beliefs underscoring the importance of listening to students.

Not only does her account highlight "how students view their roles within reform classrooms" (p. 33), but it also illuminates student ideas about the learning practices in which they are invited and expected to participate. Hodge's study affirms that these learning practices "are a part of what it means to be a *competent mathematics student* in a particular class" (italics in original, p. 33). Particularly salient in Hodge's analysis is the notion that mathematical competence looks different in different classrooms. What is competent in one classroom may not be in another. Therefore, who a student is or becomes mathematically, is constituted by intrapersonal factors, interpersonal considerations, and external influences. Hodge's study demonstrates sensitivity to these concerns by attending to considerations of identity, roles, and participation.

Although Hodge's study of student roles and mathematical competence is revealing, it leaves room for extension. For instance, her participants are "overwhelmingly Caucasian" (p. 36). Also the school was located in what teachers described as "an affluent neighborhood" (p. 36). Hodge points out the argument that "being successful in reform-based inquiry classrooms demands different forms of knowledge and of participation to which some students have access and others do not" (p. 32). The participants in her study have a greater likelihood of benefitting from these different forms of knowledge and participation than a number of the African American students who populate many urban classrooms.

Hodge's study raised a couple of questions. She purports to draw attention "to differences in student roles and mathematical competence in each class" (p. 39), yet fails to make explicit the ways that competence was assessed. Additionally, Hodge risks conflating student competence with their views of their competence. And although she notes that "there were explicit norms of participation in the classroom" (p. 39), she provides no insight as to how students are made aware of these expectations and obligations.

Jansen (2008) investigated relationships between students' beliefs and their participation during mathematics discussions. She specifically observed seventh-grade students' beliefs about participation in whole-class discussions. Jansen complemented analyses of individual students by also analyzing typical patterns of interaction during the discussions she witnessed.

Jansen (2008) conceded that "contrasting ways of interacting in the classrooms provided different opportunities to participate and opportunities to develop unique sets of beliefs and goals in each setting" (p. 80). Despite this fact, she found similarities in how students participated across classrooms and in their belief that supported such participation. Students who viewed talking about mathematics as threatening avoided discussing mathematics conceptually, even when there were opportunities to do so. These students who associated a high degree of risk with participating would engage in procedural mathematics talk.

The focus and scope of Jansen's study carry certain limitations. All of her participants were White. Although the students in this sample fairly accurately represent the school from which they were purposefully selected, the absence of African American students is conspicuous. Also, Jansen (2008) provides evidence, in the form of transcript excerpts, of "interaction segments" (p. 77), but does not offer useful glimpses of her interview protocols.

Anderson (2009) applied positioning theory to her analysis of classroom interactions. She analyzed small group interactions, which highlighted how patterns of participation, curricular affordances, and teacher goals and objective formation mediate the opportunities that students have to learn. This mediation occurs by positioning students as *kinds* of people or students, for example, "competent," or "incompetent." Anderson (p. 291) affirms:

> Somewhere between one action being deemed 'failure' and a person being called 'a failure' lies a discursive process that brings named acts of failing close enough to rub up against the sense of a person as a failure—close enough that it sticks. How many times must a student fail to succeed at math exercises to be considered a failure at math?

Studies that examine students' perceptions of mathematical competence usually refer to closely related constructs such as efficacy, self-efficacy, and attitude. The more critical of studies that explore conceptualizations of competence tend to consider aspects of roles and participation. Most often these roles and participation reflect multiple levels of positioning that occur in and beyond the classroom. Interestingly, but also unfortunately, these studies feature participants who are predominately or exclusively White. Although the significance of the results is compelling, it would not be wise to assume that the same roles and participation patterns would be observed in classrooms composed of high percentages of minority students. The next section of my literature review will examine the self-concept construct and findings from studies that included significant proportions of African American students.

Self-Concept and African American Students

The related constructs of efficacy, self-efficacy, and attitude that characterize mathematical competence perceptions also are useful in discussing theories of motivation. One consequence of the heightened attention afforded standardized testing and intensified accountability is an activation of or—perhaps, more accurately—an emphasis on what motivational theorists have distinguished as a need to achieve. Dweck and Molden (2005) point out that "achievement motivation is about striving for competence. Thus, a major part of understanding achievement motivation is understanding people's theories about competence—what competence is and what it means about the self (p. 122)." Therefore, our inquiries about competence beliefs and constructions should include investigations of the nature of the self-concept.

The literature on the self-concept motivational construct is extensive. Despite such attention, often the construct is ill defined or poorly distinguished from other psychological constructs. Schunk and Pajares (2005, p. 88) indicate that "in any particular study, self-concept may travel under the guise of self-esteem, self-awareness, self-image, self-perception, self-appraisal, self-schema, self-worth, self-evaluation, or even the self itself." Despite the attempts of some researchers to differentiate between self-concept and other motivational constructs, much of the corpus of research examining self-perceptions often makes any distinctions nebulous.

A number of views explain the self-concept. William James was one of the first psychologists to discuss the term. As he distinguished between the "self as knower" and the "self as object," James's later distinction evolved into the self-concept (Wigfield & Karpathian, 1991). Wigfield & Karpathian maintain that recent definitions are comparable to James's. Self-concept describes a collection of self-perceptions thought to be formed through experiences with the environment and the reflected appraisals of significant others (Pietsch, Walker, Chapman, 2003; Schunk and Pajares, 2005). Wigfield and Wagner (2005) indicate that self-concept is "made up of beliefs about many different aspects of self and evaluations of performance in different areas" (p. 228). Wigfield and Wagner's definition of self-concept suggests a progression from unidimensional perspectives of the construct to more multidimensional conceptualizations (Cokley, Komarraju, King, Cunningham, and Muhammad, 2003; Thomson and Zand, 2007). In other words, individuals perceive and evaluate themselves across a number of areas and specific dimensions. Research utilizing a multidimensional framework reveals that adolescents make differential self-judgments in multiple domains including academic competence, peer acceptance, and physical appearance (Thomson & Zand, 2007).

Researchers identify seven critical aspects in defining the nature of self-concept: organized, multifaceted, hierarchical, stable, developmental, evaluative, and differentiable (Schunk and Pajares, 2005). A distinction exists between individuals' perceptions involving the totality of self-knowledge and domain-specific perceptions of self. The general self-perceptions comprise the global self-concept. More domain specific self-concepts can comprise academic, social, emotional, and physical components. Academic self-concepts can encompass various subjects (for example, math, science, language arts).

In *Conceiving the Self*, Rosenberg (1986) devotes considerable attention to describing the nature, development, and social determinants of the self-concept. He explains the self-concept as "the totality of the individual's thoughts and feelings having reference to himself as an object" (p. 7). According to Rosenberg, the unique ability of humans to *stand outside of themselves* and to describe, evaluate, and respond to themselves. He calls what individuals see when they look at themselves the extant self-concept. Rosenberg asserts that an exploration of the self-concept must consider the content, structure, dimensions, and boundaries. Social identity elements, dispositions, and physical characteristics comprise the self-concept content. Dispositions refer to “certain tendencies to respond” (p. 15) and include attitudes, traits, abilities, and values. The structure of the self-concept gives insight into how an individual organizes its components. In other words, the structure reveals the centrality of psychological constructs and specifies the arrangement of self-concept components. Dimensions include things such as direction, intensity, salience, and stability. Finally, the boundaries of the self-concept help determine where “we cross the border from self to nonself” (pp. 34-35) and includes external components that individuals may experience as integral parts of themselves (e.g., the mother who speaks of “my” child).

Although more researchers have offered various interpretations, the lack of consistency in defining the general, or global, self-concept makes it easy to conflate self-concept with other self-perceptions, particularly self-esteem and self-efficacy. Obiakor (1992) considers self-esteem as “a subset of self-descriptive behaviors that reflect self-valuations” (p. 163). Self-efficacy refers to one’s perceived capabilities to organize and execute courses of action at designated levels to achieve particular outcomes (Pietsch, Walker, and Chapman, 2003; Schunk and Pajares, 2005). Schunk and Pajares (2005) posit that the reason that some researchers typically use the terms “self-concept” and “self-esteem” interchangeably is that the descriptive perceptions attached to self-concept and the “evaluative component of self-concept” reflected in self-esteem have not been empirically separated. In reviewing extant literature, in most cases I attempted to focus on studies that specified the “self-concept” construct acknowledging, however, the overlap with other psychological conceptualizations.

Bong and Skaalvik (2003) and Pietsch, Walker, and Chapman (2003) point out significant differences in self-concept and self-efficacy. Self-concept beliefs tend to be primarily affective and heavily influenced by social comparison processes. They are aggregated, yet hierarchical. Self-concept beliefs also are more likely past-oriented self-perceptions that, due to their level of generality, are more stable. Self-efficacy beliefs tend to be more cognitive and goal-referenced. They are also highly context-specific and tend to be more future-oriented. Because of their task dependence, self-efficacy beliefs tend to be more malleable.

Traditional perspectives of self-concept have begun to be critiqued in research literature. Obiakor (1992) charges that the understanding of self-concept as a highly integrated self-perception is “inadequate for addressing the specific and unique characteristics of African American students” (p. 160). Instruments used to evaluate self-concept have been standardized within White populations (Gray-Little & Hadfhal, 2000). Cokley, Komarraju, King, Cunningham, and Muhammad (2003) point out that when African Americans are represented, they are typically a small proportion of the sample. These researchers charge that these procedures can obscure important ethnic/racial differences in the structure of the self-concept construct.

Some scholars allege that racial differences in self-concept scores are oversimplified by only recognizing which group scores higher (Woodland, 2008). Woodland suggests that these differences in scores may indicate fundamental differences in self-concept among racial groups. Furthermore, he asserts that "contemporary self-concept theory and measurement reflect feelings about individual status and the achievement of individual goals" (p. 456). Woodland posits that the focus on individuality inherent in prevalent conceptualizations of self-concept could have originated, as research affirms, from the numerical domination of primarily White scholarship, i.e., research of White academics making use of subjects who are also predominately White, which conceptualized self-concept in terms of individualistic characteristics. He argues that for people of African descent, self-concept may be a derivative of both group status and the achievement of group goals, reflecting more collectivist than individualistic values.

The research on self-concept—including global and academic domains—and African Americans is, for the most part, in its infancy. Encouraging but modest progress has been made since Cokley's (2000) indictment that studies examining only ethnic minorities were "practically nonexistent" (p. 148). Recent studies involving self-concept among African Americans have begun to explore motivation in African Americans (Graham, 1994), its relationship with academic achievement (Cokley, 2000), ethnic and gender differences in measurement, links with racial identity and disidentification.

Graham (1994) provides perhaps the most comprehensive review of literature on motivation in African Americans. She chooses a narrative review rather than a meta-analysis of almost 140 empirical studies of African American motivation. She organizes the review around five topics including achievement motivation, locus of control, causal attributions for success and failure, self-appraisals and achievement-related behavior, and self-concept of ability. Graham notes that only two out of 18 studies (11%) report unambiguously that Whites had higher academic self-esteem when compared to Blacks. Both of these studies occurred in the 1960s. She also details that seven studies (39%) of self-perceived ability favored Blacks; four (22%) revealed no significant difference; and five (27%) reported mixed results. Graham's review suggests that empirical literature on general self-concept in Blacks does not corroborate the position that Blacks have negative views of self. Many social scientists had presumed that narratives of lower academic achievement (Cokley, 2000; Osbourne, 1995; van Laar, 2000), and a history of discrimination, segregation, and racism (Woodland, 2008) would diminish the general self-concept of African American students, but this seems not to be the case.

Mboya (1986) designed a study to determine relationships global self-concept, academic self-concept, and academic achievement among 211 tenth-grade African American students from five public high schools. He found no significant difference between global self-concept and academic achievement, as measured by a state achievement test. He discovered, however, significance in the difference between academic self-concept and academic achievement. Mboya also found a stronger correlation between academic self-concept and academic achievement than between global self-concept and achievement. These results attest to the multidimensional nature of the self-concept construct. The distinction between global and academic self-concept also suggests that, how these adolescents view themselves, may not be closely related to their academic achievement. In fact, some current literature (van Laar, 2000) reveals the apparent paradox that despite lower academic achievement, African American students tend to report a more positive self-concept than White students (Trusty, Watts, & Lim, 1995; Thomson & Zand, 2007).

Cokley (2000) examined the relationship between academic self-concept and academic achievement in a sample of 206 African American students. The students in his sample attended historically Black colleges and universities (HBCUs) and predominately White colleges and universities (PWCUs). Cokely investigated institutional, gender, and class status differences in academic self-concept among African American students at both types of institutions. His attention to institutional characteristics, such as racial composition, quality of student-faculty relationships, and class status (year), was both noteworthy and commendable. Cokley found no significant difference in the academic self-concept of students attending HBCUs and PWCUs. The academic self-concept of students with lower grade point averages (GPAs) at HBCUs did not differ significantly from those with higher GPAs. Cokley also found that GPA better predicts the self-concept of

African American students at PWCUs than those at HBCUs. He discovered among HBCU students that the quality of student-faculty relationships was the best predictor of self-concept. He found no significant gender differences and mixed results for class status differences. These results can suggest the premium placed on interpersonal relationships by some African Americans that may be more salient in a more racially homogeneous environment.

Other scholars incorporate racial identity into their research. Witherspoon, Speight, and Thomas (1997) examined the extent to which attitudes of racial identity and academic self-efficacy predicted school achievement outcomes for 86 African American high school students. In their study, academic self-concept, along with immersion racial attitudes best predicted grade point average, which was used as an indicator of academic achievement. Immersion attitudes are characterized by intense involvement in learning about and experiencing Black culture (e.g., learning Black history, joining groups that maintain a sensitivity to/focus on Black concerns, etc.). Witherspoon, Speight, and Thomas also note that these immersion attitudes tend to be pro-Black and anti-White. It is noteworthy that although immersion attitudes were predictive of GPA, the correlation was inverse (i.e., stronger immersion attitudes predicted lower GPAs). Academic self-concept, however was found to be positively related to GPA. The results of this study have slightly different results than those of Cokley's (2000) study, which suggested that—at the PWCUs—GPA predicted self-concept. The direction of prediction is reversed. This could possibly be attributed to developmental differences in the samples as Cokley's study was with college students, while Witherspoon et al's was with high school students, while other speculations are possible.

Awad (2007) also examined the role of racial identity, academic self-concept, and self-esteem in predicting academic outcomes for African American students. She recruited undergraduate students (mean age = 19.3 years) from a historically Black university in the northeastern United States. Extending Cokley's work, Awad utilized two types of achievement: GPA and verbal Graduate Record Examination scores. Like Cokley, she was able to indicate that self-concept predicted students' GPA. She also discovered, though, that it did not significantly predict test scores. Her decision to utilize two kinds of achievement indicators facilitated this discovery.

About a decade after her seminal review of motivation in African Americans, Graham further contributed to this corpus by coauthoring a chapter on race and ethnicity in the study of competence and motivation. Graham and Hudley (2005) bring attention to the conspicuous absence of the more contemporary constructs (e.g., achievement goals, values, and efficacy beliefs) that her earlier review failed to incorporate. They also concede that "the Graham review was guided by an intrapersonal view of motivation (individual needs, self-directed thoughts and feelings), with little attention to the larger context in which achievement strivings unfold" (p. 392). Graham and Huxley recognize the need to cast a broader net to take into account the unique factors experienced daily in the lives of people of color. Their revelation prompts them to call for acknowledgement of the structural and (socio)historical nature of a number of these factors. Furthermore, they encourage future investigations of race and ethnicity and competence motivation to begin with "a discussion of perceived discrimination and coping with racial and ethnic stereotypes as structural variables that influence achievement strivings" (p. 393).

In their extension of Graham's earlier review, Graham and Hudley (2005) added references to stereotype threat and disidentification, as they relate to competence motivation. Stereotype threat refers to "the awareness that individuals have about negative stereotypes associated with their group" (p. 397). For example, among African Americans, Steele and Aronson (1995) propose, the perceived stereotype of performing relatively poorly in academic settings could threaten the performance of students who feel their actions might confirm this negative stereotype. Graham and Hudley point out that although some students may be motivated to work hard to disprove the stereotype, other students may minimize the significance of performing well in academic tasks. "Disidentification" describes the disengagement of self-esteem from academic performance (Osborne, 1995). Students who are said to disidentify no longer view academic achievement as essential to their self-definition (Graham & Hudley, 2005).

Using a nationally representative weighted sample, Osborne (1995) researched relationships among academic achievement, self-esteem, and race over the two-year period between the eighth grade and tenth grade. Osborne reported that

African Americans scored lower on measures of achievement than Whites in the tenth, but not eighth, grade. He also found that African Americans at both grade levels reported higher global self-esteem. Male and female students from both racial groups identified with academics. That is, their self-esteem and their academic outcomes showed significant correlations. Although neither change was statistically significant, correlations between self-esteem and achievement outcomes decreased from $r = .235$ to $r = .192$ over the two-year period, whereas the correlation increased for White males. Osborne also presents a nonsignificant decrease from $r = .260$ to $r = .207$ as evidence of disidentification among African American female students.

Although he included (self-reported) grade point average as one of the variables of his study, Osborne also administered a battery of four academic achievement tests in the reading, math, science, and history content areas. His incorporation of this battery of tests distinguishes his study from many others investigating the relationship between self-beliefs and academic achievement. Caution should be taken in interpreting these results, since even though he used domain specific tests, the global instrument for self-esteem that he utilized may not have been sensitive to the multidimensional nature of students' self beliefs.

Cokley, McClain, Jones, and Johnson (2011) stress the significance and importance of studying disidentification, especially among African American males whose self-esteem and academic self-concept appear to be "virtually uninfluenced by academic outcomes" (p. 56). In a fashion relatively consistent with

Osborne's research, Cokley, McClain, Jones, and Johnson (2011) examine academic disidentification among African American adolescents and utilize grade point average (GPA) as an indicator of academic achievement. Like Osborne, the researchers apply the definition of disidentification as "the attenuation of the relationship between academic self-concept and academic outcomes" (p. 58). Unlike Osborne, however, they also incorporate racial identity into their investigation. More specifically—since racial identity is theorized as a multidimensional construct—they explore the racial centrality dimension. The researchers define centrality is "the degree to which race is a core part of an individual's identity and self-concept" (p. 58).

One-way analyses of variance indicated that differences in self-concept between males and females were not significant. Correlational analyses revealed a moderate relationship ($r = .50$) between grade point average and self-concept. The correlation of academic self-concept and GPA attenuated from $r = .87$ for younger African American males to $r = .30$ for older males. Students ranged in age from 15 to 19 years old. Although younger African American females were not as strongly identified ($r = .19$), the correlation of academic self-concept and GPA significantly increased to $r = .49$. The researchers concluded that African American males experienced disidentification, while African American females did not. Also, all students' academic self-concept positively predicted GPA, while age and racial identity negatively predicted GPA. Interestingly, the research of Osborne (1995) and Cokley, McClain, Jones, and Johnson (2011) considers academic disidentification in terms of the attenuation of the correlation between academic self-evaluations and academic outcomes. A distinguishing difference, however, is that Osborne utilizes self-esteem, and Cokley et al. employed self-concept as the self-evaluation construct. This type of "interchangeability" reflects the kind of conflation that confuses and minimizes distinctions between these constructs. Consequently, relationships among academic self-concept, academic self-esteem, race/ethnicity and academic outcomes may be obfuscated by the lack of specificity inherent in conflating motivational constructs.

Along with exploring the interactions of racial/ethnic components of identity with academic self-concept, researchers have begun to investigate sex and gender differences in the relationship among academic self-concept, achievement-related beliefs, and achievement. Trusty, Watts, and Lim (1995) report self-concepts differing based on gender. Thomson and Zand (2007) emphasize that much of the work on the multidimensional self-concept framework has focused on the sex differences in predominately White samples. They maintain that despite the fact that the observed sex effect explains less than 3% of the variance, sex differences continue to be reported. Thomson and Zand argue that the literature fails to appreciate the explanatory power of gender identity on self-concept evaluations. They assert that how individuals feel about the "masculine" or "feminine" traits they possess may impact self-evaluations in a greater way than only their biological sex.

Thomson and Zand report that "with the exception of the present [2007] study, to date, no research has been conducted investigating the relationship between gender identity and self-concept among African American adolescents. In their study of sex and gender differences in multidimensional self-concepts of 174 African American adolescents, they determined that gender identity accounted for from 9% to 23% of the variance in self-concept differences. Their study found that sex significantly predicted three of six self-concept domains: Friendship/Acceptance, Athletic Competence, and Romantic Appeal. For each of these, males provided more positive self-judgments than females. Academic/General Competence, along with Physical Appearance and Behavioral Conduct, was not found to be significantly predicted by sex. Consequently, academic competence was excluded from further criterion testing. Although these quantitative explorations have not revealed explicit relationships between academic competence, and sex/gender, qualitative (or mixed-methods) inquiries may be more effective in illuminating the nature of relationships among these variables.

In sum, contemporary research on self-concept has recognized the construct as multidimensional, hierarchical, and multifaceted. The fact that African American students' tend to report higher global self-concepts than other populations, although underperforming on a number of academic outcomes, has confounded researchers who offer with their research multiple—often competing—theories and explanations. The relationship among the more domain-specific academic self-concept and academic achievement continues to warrant investigation. Although inquiries into this relationship are worthwhile, further research should continue to explore the multidimensional, hierarchical, and multifaceted nature of the self-concept construct by including examinations of interactions with demographic categories such as age, gender, and race/ethnicity. In the face of relatively lower mathematics achievement scores on national assessments, potentially stereotypically threatening situations, risks for academic disidentification, and the ubiquitous likelihood of more inequitable experiences with mathematics education,

the conceptualizations that African American students construct about mathematical competence—along with their math self-concept beliefs—beg further scholarly attention.

Chapter Three:
METHODOLOGY

This project investigated the constructions of mathematical competence that a group of African American students form and the manner in which they construct them. This study also examined the participants' math self-concept beliefs and their formation. More broadly, this study aimed to understand how these students experience mathematics as a result of these formations and constructions.

This research posed the following questions:

1. What mathematical competence beliefs are held by a sample of adolescent African American students?
2. What mathematics self-concept beliefs are held by a sample of adolescent African American students?
3. In what ways do these students reveal that they construct these math competence and self-concept beliefs?

This study used a multiple case study qualitative design to address these research questions. This research explored students' mathematics competence and self-concept beliefs and their construction. Yin (2009) posits that case study inquiry is a "preferred method" when the focus is on a contemporary phenomenon in real-life contexts, when "how or "why" questions are advanced, and when the investigator exercises little control or influence over events and circumstances. As this research investigated the contemporary phenomenon of the construction and formation of mathematics self-ideas that escape, ideally, the influence of the researcher, case study inquiry was well suited for this exploration. Applications of case study research to explain, to describe, to illustrate, and to enlighten (Yin, 2009) also made it a sound choice for this inquiry.

Merriam (1998, p. 41) maintains, "Case study offers a means of investigating complex social units consisting of multiple variables of potential importance in understanding the phenomenon. Anchored in real-life situations, the case study results in a rich and holistic account of the phenomenon." Further, she posits that the "interest is in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation (p. 19)." This multiple case study aims to be both particularistic—focusing on self-beliefs of a specific group of students regarding mathematics competence, and descriptive—presenting a detailed account of the phenomenon of the construction of these mathematics self-ideas. Stake (1995) confirms that a main goal of case study is such particularization, not generalization. Even more broadly, though, Stake argues that "the function of research is not necessarily to map and conquer the world but to sophisticate the beholding of it (p. 43). According to him, case study emphasizes uniqueness and implies that the researcher must distinguish how the case is different from others. In attending to this concern, this research offers rich descriptions of a collection of six individual case studies each focused on exploring mathematics competence and self-concept beliefs. In following in the tradition of Stake, since each case is a person, descriptions of home and family contexts are vital elements of the study. Attention is often given to the physical situation also in order to develop vicarious experiences for the reader.

Although this multiple case study was designed as a qualitative exploration, it used and referenced data from the administrations of a questionnaire, an inventory, and subscales of an attitudinal scales instrument. The Self-Description Questionnaire II (SDQ-II; Marsh, 1992) (Appendix A) measures academic self-concept in adolescents. This study used the 10 items focusing of mathematics self-concept as some of the prompts and probes in discussions with participants about their experiences with mathematics. The Multidimensional Inventory of Black Identity-Teen (MIBI-T) (Scottham, Sellers, and Nguyen, 2008) examines the racial identity for African American adolescents. In this study, the MIBI-T (Appendix B was administered to help gauge the centrality of race in participants' self-beliefs. Subscales (Appendix C) from the Fennema-Sherman Mathematics Attitudes Scales (1976) were used to gauge students' feelings about (their) success in mathematics, their feeling about significant others' (parent, peers, teachers) thoughts about their ability, and the degree to which they perceive mathematics as a gendered [male] domain. Again, these instruments provided a springboard to explore student responses qualitatively by informing questions that guided interviews and other conversations with student (and parent) participants.

The sample for this study was comprised by six of the participants in a 2011 qualitative pilot study that similarly explored adolescent mathematics competence beliefs. This expanded study now also includes single interviews with participants' parents. Interviews grew to be "guided conversations rather than structured queries" (Yin, 2009, p. 106). Yin explains that these kind of focused interviews "still remain open-ended and assume a conversational manner, but you are more likely to be following a certain set of questions derived from the case study protocol" (p. 107). Texts from focused interviews with students and parents formed the bulk of data for analysis as these data from instruments (SDQ-II, MIBI-t, Fennema-Sherman subscales) were clarified in the course of participant interviews.

Still, other documents served as further data for analysis. Students composed mathematical autobiographies (Appendix D) in which they gave details of significant periods in their development of their self-ideas involving their mathematical development. Students also graphically represented their descriptions of themselves and revealed aspects of self-esteem beliefs in (researcher modified) social knowledge structures (SKS). In the SKS (Appendix E), students also shared notions and associations of gender with some of the traits they came to characterize themselves as possessing. Students recorded in a mathematics log (Appendix F) instances where they felt that mathematics knowledge was relevant and applicable. These logs gave insight into the kinds of activities that students viewed as mathematical and the types (content) of mathematics that they associated with the experience. Lastly, I kept a journal in which he maintained descriptive and reflective field notes and this became a final source of data.

Participants and Setting

The participants in this study were adolescent (seventh-ninth-grade) African American students from a metropolitan city in the southeastern United States.

Students recruited to participate were enrolled in a three-week academic enrichment summer program in 2011 that will be called *Channel the Challenge* (CtC). The organization's stated vision for youth attendees was "that all middle-grades students, regardless of income, ethnicity or home life can work toward increased: skills as a students, confidence as a learner, competency in a global society, and comfort with taking on leadership" (personal communication,

CtC originated on another southeastern university campus and was run from 1990 to 1995 as a summer program for youth with learning disabilities. Students in the original program were primarily from middle-class White families. When one of its founders became an administrator at the present university site, the program was re-envisioned with the new setting in mind. The CtC program was designed with consideration of the best principles advocated by the National Institute on Out-of-School Time (Hall, Israel, & Short, 2004). These principles incorporated academic, social and fitness instruction in the setting of a university campus.

In 2004, the university's Division of Educational Studies led the effort and welcomed the sponsorship of the university's graduate school. In 2011, the program boasted, "We are in our 8th year having touched the lives of over 340 students and have provided guidance to 2 other … institutions of higher education that have aspired to create their own program similar to ours" (Emory University, n.d.). In 2010, CtC had been identified by the National Summer Learning Association as one of the top five summer learning programs in the United States.

The program curriculum emphasized integrated learning experiences. Instruction highlighted learning for school, learning for life, and learning for health. CtC integrated learning strategies and study skills into its academic classes. Students were able to select two out of the four academic classes—mathematics, science, language arts, and social studies. Each academic class focused on topics addressed in state content standards.

The summer mathematics class focused on “the artistry of geometry.” The course emphasized the ubiquity of mathematics. The class highlighted how mathematics appears in natural phenomena, such as beehives and pineapples, and within man-made constructions such as architecture and artwork. Students studied concepts such as tessellations, symmetry, conic sections, and icosahedrons. Students created various forms of art including string art, straw structures, and tessellated artwork.

Along with their academic classes, students also chose two physical education classes from selections that include badminton, basketball, beach and camp games, and soccer. Daily special classes were conducted before lunch. These classes provided opportunities for students to explore prior interests and develop new ones. Topics included African drumming, cooking, etiquette, step dancing, and yoga. The day ran from 8:30 am until 4:00 pm and students were permitted a swim in the outdoor pool at the end of the day.

The 2011 summer program accepted 72 middle school students. The admission process included submitting online information, a letter of recommendation, and a student writing sample. Families incurred an application fee of $50 and a tuition fee of $1200. About one third of participants received full scholarships; another third, partial scholarships; and the remaining third paid full tuition. The CtC program provided considerable scholarship support to families in need and in many cases, additional financial support was also provided by students' home schools, districts, or sponsoring institutions.

Youth participants who received the largest scholarships were identified primarily through community partnerships and parental outreach strategies. Community partnerships included a local urban ministry, a nursing school, a medical school, public school systems, a school system's homeless liaison, a community food bank, and an Asian community service organization. Parents and other interested adults were able to locate summer youth opportunities through CtC's web presence.

The program served a diverse student population. The CtC brochure stated that the program is "appropriate for both average and advanced learners from a broad range of backgrounds and experiences." Numbers of girls and boys in the program were approximately equal. Also, the amount of sixth-, seventh-, and eighth-grade students was distributed fairly evenly. The reported racial/ethnic composition in 2011 was 62% African American, 12% Hispanic, 15% White, and 6% Asian American.

Participants for the dissertation study comprised two groups; the first, African American adolescent students, and the second, their parents. Each of the six students selected to enroll in this study had previously taken part in an empirical study with the researcher during 2011 that served as a pilot study for this current research. The mean age of the six student participants (three male and three female) was 13.7 years old.

Student participants were selected largely from their self-reported responses to the Self-Description Questionnaire II (SDQ-II)(Marsh, 1992). The SDQ-II is an instrument that evaluates the multidimensional self-concept of adolescents. My purposeful sample selection was attentive to student responses to questions in the SDQ-II about feelings and attitudes regarding mathematics and experiences with the subject. The items of the SDQ-II are displayed in Appendix A. As much as possible within the constraints of a six-subject sample size, I attempted to select students who demonstrated various levels of interest, motivation, achievement, and confidence in mathematics.

The student sample demographics are reported in table 1. These are followed by a brief profile of the six participants in this sample. I have tabularized other descriptive data, such as school configuration, in Appendix G. In addition to these students, each of the parents with whom these participants lived agreed to participate in the study. These parents consented to an interview about some of their own experiences with mathematics, along with experiences they have as parents of African American students of mathematics.

Table 1. Number and Grade Level of Student Participants

	Girls	Boys
Grade		
7	1	
8		1
9	2	2
Total	3	3

Participant Biographies

Tamar. Tamar was 14 years old and had finished the eighth grade. She attended a public middle school in the midst of a community undergoing continued gentrification. The school served 330 students, 98% of whom are African American. The school's mission is "to develop lifelong learners who are confident, competent, contributing members of society. Through challenging learning opportunities we will prepare our students to be high achievers, whose academic achievement is comparable to or exceed the national average." Approximately 84% of its students met or exceeded the target on the state math assessment.

Tamar is a quick learner. She completed activities before many of her peers. She sat at the front of the summer math class. She sometimes seemed disinterested or withdrawn—removed from the activity of students who were attempting to understand concepts or procedures. This may have been because of how soon she typically completed her tasks. Yet she was patient, often assisting her classmates as she awaited further instruction. She was a Daily Challenge Winner during the program.

Omari. Omari was 13 years old and a rising eighth-grader. He attended school in a city over 150 miles from the summer program. His public school served almost 800 students. Approximately 86% of students were African American; 14% were Caucasian. Seventy three percent of the student population comes from economically disadvantaged families. The school had recently achieved Adequate Yearly Progress (AYP). Omari is easy to talk and listen to. This also appeared to be the case with the friends he made during the program. Omari was a CtC Daily Challenge Winner.

Aminah. Aminah attended a public middle school which served under 850 students. Her school had an International Baccalaureate (IB) program which helped to make its cluster the first in the southeast to have a K-12 IB continuum. The school boasted a completely renovated, state-of-the-art facility that included a conference center, new media center, nine science laboratories, five computer laboratories and a performing arts center. The school finished first place in the junior division of the Andover-Dartmouth Math Competition in 2006. The institution placed first in the city in the national Math Counts program.

Aminah was thirteen years old going to the ninth grade. She was very comfortable in the bookstore where I met her, her brother Ose, her mother, and younger sister. She explained that she liked words and is interested in learning. She wore small, shoulder-length dreadlocks. Aminah's reasonable questioning of the relevance of a survey question suggested that she was not rash or impulsive, but instead a careful and thoughtful thinker. Her mother maintained that Aminah may be believed by others to be good in math. Aminah seemed comfortable expressing her own thoughts regarding her experiences. After our conversation I found the reading table where her mother, her younger sister, and younger brother sat with a Spanish-English dictionary.

Tyson and Bryan. Tyson and his fraternal twin brother Bryan were fourteen-year old rising ninth graders at a Christian academy committed to standards of Christian education using the classical method of the Trivium. The Trivium describes a classically focused curriculum that emphasizes grammar, logic, and rhetoric. Their academy aims to deliver a Christ-centered education. The school website includes a statement of faith and a vision of “joyful submission to God.” The curriculum is designed for students to maximize the gifts and talents they received from God. Fees for the 2011-2012 academic year for grades 7-12 were $8,400 for each student. They were about to transition to a local public high school.

Tyson and Bryan are diminutive teens who were more than willing to share their summer CtC experiences. Last summer, they were escorted by their mother to our meeting at the county library west of the metropolis. Tyson was eager, energetic, and expressed an affinity for mathematics. Bryan was more deliberate and thoughtful about his responses. Despite good grades, he expressed—to the surprise of his mother—considerable frustration with his last year of mathematics.

Gabourey. Gabourey attends an independent coeducational elementary school. The school is grounded in frameworks of Christian faith and Jewish heritage. The school served approximately 630 students during the 2011-2012 year with tuition for K-6 for the same year surpassing $19,000. The school provided more than 350 computers on campus with over 140 laptops and tablet personal computers.

Gabourey is the youngest participant. She was 12 years old and entering the seventh grade. She was small, but has considerable presence. She made it clear that she did not like mathematics. She was likeable and endearing. Her popularity helped her to garner a CtC Camper of the Week award at the end of the first week of the program. She also secured an opportunity to offer student remarks at the program closing ceremony.

Data Collection and Analysis

Robert Stake (1995) argues that "all research is a search for patterns" (p. 44). He maintains that as researchers search for meaning, their search is fundamentally a quest to recognize patterns in an attempt to "understand behavior, issues, and contexts" (p. 78) with regard to our specific cases. Stake suggests that we can look immediately for patterns as we interview, observe, and review documents or as we code records and aggregate frequencies. This research in the form of a multiple case study relies on two stages of analysis: within-case analysis and cross-case analysis (Merriam, 1998). The within-case analysis provides a detailed description of each case and its themes. The cross-case analysis then analyzes themes across the cases and provided assertions or an interpretation of the meaning of the cases (Creswell, 2007).

Instead of the goal of statistical generalizations, this dissertation research—as case studies do—had as an objective the production of analytic and naturalistic generalizations. Yin (2009, p. 38) explains that in analytic generalization “a previously developed theory is used as a template with which to compare the empirical results of the case study.” This dissertation relied on theories and frameworks conceptualized largely in educational psychology principally with regard to mathematics self-concept and mathematics education principally as related to mathematics identity and socialization as lenses through which data are analyzed.

Stake (1995) explains that “naturalistic generalizations are conclusions arrived at through personal engagement in life’s affairs or by vicarious experience so well constructed that the person feels as if it happened to themselves” (p. 85). He recommends emphasizing time, place, and person as three major steps in assisting the reader in making naturalistic generalizations. Furthermore, he insists that accounts should be both personal and inclusive of sensory experiences. Following Stake’s prescription, this dissertation used narrative accounts, stories, chronological presentations, and “personalistic descriptions” (p. 87) to provide opportunities for vicarious experience.

The dissertation research foci were investigated through the use of individual semi-structured interviews that although focused, remained open-ended and conversational as the primary data source. Along with students, at least one parent was interviewed. Data were also collected from instruments measuring adolescent self-concept (SDQ-II), evaluating attitudes towards and about mathematics (Fennema-Sherman Scales), and assessing racial identity (MIBI-T). In addition to completing the SDQ-II and the Multidimensional Inventory of Black Identity-Teen (MIBI-T) instruments, students were asked to create documents for analysis. They were also asked to diagram a schematic representation of their self-concept, self-esteem, stereotypes and attitudes. This schematic graphically illustrated participants' interpretations and associations among these psychological concepts. They conceived and wrote mathematical autobiographies that highlighted some of their significant experiences with mathematics and their understanding of implications of these experiences. In a journal that I provided, students recorded entries of their recognition of mathematics in some of their day-to-day activities and experiences. Details specifying the implementation of these instruments and documents follow.

Student Interviews

A considerable portion of data for this study took the form of digital audio-recorded individual student interviews. Over the course of the project, three interview sessions with each participant resulted in a total of 817 minutes of student interview data. This averaged to just over 136 minutes per student spread over the three interview sessions or approximately 45 minutes per student interview. During the initial interview session, students completed the Self Description Questionnaire II (SDQ II) a social knowledge structure (SKS) schematic, and subscales of the Fennema-Sherman Mathematics Attitudes Scales (1976). These documents were analyzed to ascertain students' associations corresponding to the socio-psychological constructs of self-concept, self-esteem, stereotype, and attitude

(Greenwald, Rudman, Nosek, Banaji, Farnham, and Mellot, 2002). A description of these instruments follows in the next section.

During the initial interview, I specified the purposes of the study to the participants and answered any of their questions regarding their participation. Since these students had participated in the pilot study with a largely similar focus during the previous academic year, some time was spent reviewing the school year and any changes and developments to math competence and self-concept beliefs that it might have brought to them. I further explained that they were expected to compose a mathematics autobiography to document their experiences, understandings, and interpretations of mathematics. Students were asked to record in a math log at least 10 instances within a month where they recognized that they made use of mathematical notions or reasoning. As participants were also expected to compose a mathematical autobiography, the details of this responsibility were explained during the initial interview.

During the second interview, participants completed the Multidimensional Inventory of Black Identity-Teen (MIBI-T) (Scottham, Sellers, and Nguyen, 2008). This instrument helped me to get a sense of racial/ethnic aspects of students' self-concept. During the second interview, I delved deeper into student narratives with questions that further explored their experiences with school and school mathematics. Interview questions were designed to investigate students' beliefs about mathematics and math competence, along with their estimations of their cognitive (particularly mathematical) competence and self-concept. Interview protocols are in Appendix H. My review of their SDQ-II and the transcripts of the previous interview sometimes inspired clarifying conversations during the second interview. Parent interviews were scheduled between students' second and third interviews.

During the third student interview, students were able to respond to questions that may have been inspired by conversations with parents. This third interview also emphasized follow up questions and probes to previous discussions. The protocol highlighted students' beliefs about mathematics (Franke & Carey, 1997); (Kloosterman and Cougan, 1994); (Kloosterman, Raymond, Emenaker, 1996) perceptions of competence and attitudes regarding math achievement (Harter, 1982; House, 2006; Papanastasiou (2000), explored their expectations of mathematical success and their valuation of mathematics (Wigfield, Eccles, Yoon, Harold, Arnreton, Freedman-Doan, & Blumenfeld, 1997), and emphasized their interpretations of their experiences as African American middle school mathematics students (Murrell, 1994). Finally, this interview included consideration of participants' gender beliefs and associations regarding mathematics and math competence. Secondary and tertiary participant interviews wove into their texts the ongoing feedback received in from the Self Description Questionnaire II (SDQ-II), the schematic social knowledge structure, Fennema-Sherman subscales, the Multidimensional Inventory of Black Identity-Teen (MIBI-T), mathematical autobiographies, and log entries.

Interviews were transcribed and analyzed by identifying and grouping segments of transcripts as they related to developed categories. This type of data analysis relied on open coding (Strauss & Corbin, 1990) in developing themes that emerged and cut across interviews. The analysis involved multiple phases of coding. The final coding key is found in Appendix I.

Instrumentation

Self-Description Questionnaire II. The Self Description Questionnaire II (Marsh, 1992) was designed to measure self-concept in adolescents in middle and early high school. The instrument was developed from the original SDQ-I (Marsh, 1988), which was used primarily with elementary students from grades four to six. The SDQ-II consists of 102 items, which assess three areas of academic self-concept, seven areas of nonacademic self-concept, and general self-concept. The subscales that address these areas are Physical Abilities, Physical Appearance, Opposite-Sex Relations, Parent Relations, Honesty-Trustworthiness, Emotional Stability, Math, Verbal, General School, and General Self. Reliability coefficients for each scale vary from 0.83 to 0.91. The Math subscale possesses strong internal consistency of $\alpha = 0.90$. As adolescents complete the SDQ-II, they respond to declarative statements (e.g., Mathematics is one of my best subjects, I have always done well in mathematics) by selecting one of six choices: False, Mostly False, More False Than True, True, More True Than False, Mostly True, or True.

Social Knowledge Structures. Another instrument that participants' utilized to express their self-concept and social knowledge was the researcher-modified social knowledge structure (SKS). This schematic representation was a modification of the graphic utilized in Greenwald, Rudman, Nosek, Banaji, Farnham, and Mellot

(2002) proposed unified theory of implicit social cognition. The graphical structure reflects associations regarding self-concept, self-esteem, stereotype, and attitude. In the social knowledge structure, “associations are relations between pairs of concepts that can be represented by familiar node (concept) and link (association) diagrams” (Greenwald, Rudman, Nosek, Banaji, Farnham, and Mellot, 2002, pp. 4-5). Greenwald, Rudman, Nosek, Banaji, Farnham, and Mellot acknowledge recent work that identifies self as a central entity in structuring social knowledge. Therefore, the diagrammatic center of the schematic is the self. Ovals are nodes that represent concepts that “are assumed to be activated either by external stimuli or by excitation through their associations with other, already active, concepts” (p. 5). Greenwald, Rudman, Nosek, Banaji, Farnham, and Mellot also incorporate the strength of association and explain it as “the potential for one concept to activate another” (p. 5). The strength of association is indicated by line thickness. Valence expresses the positivity or negativity associated with an experience or thought. Gender associations are available for participants to make. The gender icons utilized by Greenwald, Rudman, Nosek, Banaji, Farnham, and Mellot were replaced with female and male symbols that would be more recognizable to adolescents.

Before asking them to complete a social knowledge structure (SKS) graphic, I offered an example to explain to participants. The example was an SKS that I constructed, explaining my thought processes at each step as the graphic was being created. After providing this example, I asked students to list traits or attributes that they would use to describe themselves. In their description, students were encouraged to consider and list (on a separate sheet of paper) roles and relationships that they have. Students made connections between themselves and the descriptors they invoked. They represented these associations graphically with line segments that connected their descriptors. Students indicated their associations of particular descriptors as positive or negative (valence), and/or as feminine or masculine (gender ascription). Student-constructed social knowledge structures are collected in Appendix J.

The social knowledge structure (SKS) revealed sensitivity to participants' attitudes about and estimations of their self-concept. In the absence of an explicit measure of gender identity, the SKS provided some representation of students' associations of aspects of their self-concept with gender attributes. As the valence component reflected how positively/negatively participants feel about their associations, these associations also revealed these adolescents' susceptibility and adoption of stereotypes (racial/ethnic, gender, etc.).

Fennema-Sherman Mathematics Attitudes Scales. The Fennema-Sherman Mathematics Attitudes Scales (1976) were designed to assess various attitudes related to learning mathematics. Student participants completed the following subscales: The Attitude Toward Success in Mathematics, Mathematics as a Male Domain, Mother, Father, and Teacher scales. The Attitude Toward Success in Mathematics scale measures "the degree to which students anticipate positive or negative consequences as a result of success in mathematics" (p. 2). The

Mathematics as a Male Domain scale assesses the degree that individuals perceive mathematics "as a male, neutral, or female domain" (p. 3). The Mother, Father, and Teacher scales were developed "to assess students' perceptions of these persons' attitudes toward them as learners of mathematics" (p. 3). Each scale contains six positive stated and six negatively stated items with five responses ranging from strongly agree to strongly disagree. Split-half reliabilities for The Attitude Toward Success in Mathematics, Mathematics as a Male Domain, Mother, Father, and Teacher scales are .87, .87, .86, .91, and .88, respectively.

Multidimensional Inventory of Black Identity-Teen (MIBI-T). The Multidimensional Inventory of Black Identity-Teen (MIBI-T) is a relatively "new measure of racial identity specifically for African American adolescents" (Scottham, Sellers, and Nguyen, 2008, p. 297). The measure consists of seven subscales that operationalize three stable dimensions (centrality, regard, and ideology) of another instrument, the Multidimensional Model of Racial Identity.

The centrality dimension of racial identity refers to "the extent to which an individual normatively emphasizes racial group membership as part of his or her overall self-concept" (p. 297). Regard refers to an individual's affective and evaluative judgment about African American group membership. It comprises two subdimensions: public and private regard. Public regard describes the extent to which individuals feel that *others* positively or negatively view African Americans. Private regard defines "the extent to which an individual feels positively or negatively toward the African American community as well as how she or he feels about being a member of this community" (p. 297-298).

The racial ideology subdimension refers to a person's beliefs and attitudes about the way(s) that members of the African American community *should* act. The ideology scale comprises four subscales (Nationalist, Minority, Assimilationist, and Humanist). The nationalist ideology emphasizes the particular uniqueness of being African American. It is often characterized by support of African American organizations and social environments (298). The oppressed minority viewpoint draws parallels between the experiences of African Americans and other oppressed minority groups. The assimilation perspective highlights the similarities between African Americans and "mainstream" society (298). The humanist ideology highlights similarities between all people, irrespective of race. Higher scores represent greater endorsement of the ideology.

The final model of the MIBI-T includes 21 items (3 items per subscale). This measure is significantly shorter than the original MIBI (56 items). This was important to consider as adolescents have a relatively shorter attention span when compared to adults. The design of the MIBI-T better enabled participants to maintain their focus when completing the measure. On the MIBI-T, participants were asked to respond to items using a 5-point Likert scale ranging form strongly disagree to strongly agree to indicate the extent to which they agree/disagree. Scottham, Sellers, and Nguyen (2008) report reliability coefficients for the Centrality Scale, the Public and Private Regards subscales as $\alpha = .55$, $\alpha = .66$, and $\alpha = .76$, respectively. The Nationalist, Minority, Assimilationist, and Humanist subscales have reliability coefficients of .70, .57, .70, and .50, respectively.

Upon first inspection, these Cronbach alphas appear unimpressive. But, by utilizing the Spearman-Brown formula, Scottham, Sellers, and Nguyen (2008) estimated what the reliability coefficients would have been if the current subscales contained the same amount of items as the original MIBI, from which the MIBI-T was derived. The estimated Cronbach alphas that resulted were significantly improved and were then reported as: Centrality, $\alpha = 0.78$; Public Regard, $\alpha = 0.79$; Private Regard, $\alpha = 0.87$; Nationalist, $\alpha = 0.87$; Minority, $\alpha = 0.80$; Assimilationist, $\alpha = 0.88$; and Humanist, $\alpha = 0.75$. Participant responses to the MIBI-T are found in Appendix K.

Participant-Generated Text Documents

Each student participant was provided a 10 in. by 8 in. wide-ruled, marble covered composition notebook. They were asked to construct texts that were analyzed to interpret students' conceptualizations of mathematical competence and estimations of math self-concept. Texts included students' mathematical autobiographies and a mathematics log. These text included students' reflections about mathematics and mathematical relationships, and math competence.

Mathematical Autobiographies. The mathematical autobiography had the purpose of helping students to reflect on their experiences with mathematics. The idea for student autobiographies was inspired by Robert Berry (2002), who used them in his dissertation to provide portraits of successful African American male students. My participants were expected to identify and write about what they perceived to be significant moments and events in their mathematical histories. They were asked to focus on significant events and histories, and to reflect on how they felt about and interpreted these events. Moreover, participants' autobiographies provided insight into some of the ways that students responded to their mathematical environments. Each participant wrote one mathematical autobiography. Students had the choice to handwriting or typing their autobiographies. Autobiographies were collected before the second interview. The protocol for the mathematical autobiographies is found in Appendix D.

Math Logs. Participants were also asked to keep math notes documenting occurrences, events, and situations that make them think of math (trips to grocery store, interpretations of sports statistics, etc.). They were encouraged to write at least one to two paragraphs each week detailing such experiences and the mathematics that they understand to be associated, explicitly or implicitly with the phenomena or occasions. The mathematical experiences that students recollected and shared were drawn from situations that arose in the classroom, at home, or in other places. The primary purpose of the math notes is to better understand participants' associations and conceptualizations of mathematics. Student math logs are collected in Appendix L.

Researcher Fieldwork Journal

I kept a journal that included field notes and personal observations and reflections. Field notes included descriptions of the setting and people. Field notes also contained direct quotations and how these may have struck me or inspired particular associations. Any other observations or thoughts that I might have had at the time were also recorded in this field journal.

The researcher journal served to record field notes and to document more subjective elements such as "ideas, fears, mistakes, confusion, and reactions to the experience … [along with] … thoughts about the research methodology itself" (Merriam, 1998, p. 110). I recorded thoughts about participants and my interactions and evolving relationships with them. I included within my documentation both new and, perhaps, dormant feelings about my past, present, and future experiences with issues of competence and the development of these conceptualizations, and the relationship of my own narrative of the journey of competence to those of his student and parent participants.

Parent Interviews

I interviewed at least one parent of each participant to help contextualize the participant's conceptualizations of mathematical competence and math self-concept. The average duration of the single interview with parents was 74 minutes. In these interviews, parents were asked to describe their child's mathematical abilities and histories, along with providing an estimate and summation of their own. By inquiring about family academic decisions, parent interviews revealed motivations for pursuing in some cases—allowing in others—their children to follow particular mathematics course trajectories. Parents included information about their child's teachers, and reflections about teachers they had when they themselves were children. This information provided insight into their family's stance on education.

Interviews with parents revealed their expectations of their child and parents' understanding of their role(s) in the child's (math) education. As parents reflected on their own experiences and those of their children, their insights helped to illuminate sociohistorical dimensions of mathematical identities and self-concepts in formation.

Robert Berry's research (2002) exploring the school and mathematical experiences of African American middle school students offered a template for the type of questions that comprised the protocol for my study's parent interviews. The Mother and Father scales of the Fennema-Sherman Attitudes Scales (1976) (Appendices C1 and C2) provided additional guidance for parent interview protocol design. Although these scales were designed "to measure *students' perception* of their mother's/father's interest, encouragement, and confidence in the student's ability, " (p. 3, emphasis added) the statements that comprise them were adapted to formulate the questions of the parent interview protocol for the present study. Fennema and Sherman reported split-half reliabilities for the Father and Mother scales as 0.91 and 0.86, respectively.

Conversations with students sometimes provoked questions for the researcher to pose to parents, and vice versa. I attempted to schedule parent interviews after the second participant interview has concluded, yet before the third participant interview. This allowed me to ask students questions that may have been provoked by conversations with their parents. The protocol for the interview with parents appears in Appendix M.

Reliability

Reliability addresses "whether the process of a study is consistent, reasonably stable over time and across researchers and methods" (Miles & Huberman, 1994, p. 278). Creswell (2007) points out that in a multiple case study, "the one issue or concern is … selected, but the inquirer replicates the procedure for each case" (p. 74). During this research, as much as possible, procedures were repeated with all participants. A case study protocol was developed and maintained. This protocol contained instruments and interview questions used in the study along with procedures and general rules to be followed. Also, a case study database was maintained for each student participant. The case study database contained interview protocols, notes, student inventory responses, and transcripts, and other participant documents (e.g., autobiographies, math logs). The database revealed actual evidence and indicated the circumstances (time, place, etc.) under which evidence was collected (Yin, 2009). Reliability was strengthened by maintaining what Merriam (1998) calls an "audit trail," or what Yin (2009) calls a "chain of evidence." The audit trail was established through detailed descriptions of how data were collected and how decisions were made throughout the study. The chain of evidence was primarily advanced by making sufficient citations to relevant sections of the case study database and by citing specific documents, interviews, and observations (Yin, 2009).

The interview protocols were developed primarily from reviews of similar research interests and from subscales from instruments such as the Student-Description Questionnaire (SDQ II), the Fennema-Sherman Mathematics Attitudes scales, and the Multidimensional Inventory of Black Identity-Teen (MIBI-T). I invited the input of colleagues and other members of the mathematics community to insure greater fidelity to the dimensions captured in these instruments. The interview protocols were piloted during an empirical study with adolescent students last and then modified.

In order to insure the accurate coding of interview data, coding checks were conducted. Colleagues, who had completed graduate coursework in qualitative methods, were given my code key (Appendix I) and were asked to code uncoded portions of an interview. My coded interviews and theirs were compared and achieved a final agreement of 81.8%. Agreement was established using the following formula (Miles, & Huberman 1994, p. 64):

$$\text{Reliability} = \frac{\text{number of agreements}}{\text{total number of agreements + disagreements}}$$

Internal Validity

Internal validity addresses the question of whether or not researchers actually observe or measure what they believe and intend to observe and measure (LeCompte & Goetz, 1982). Merriam explains it simply as addressing how research findings match reality. In order to improve internal validity, I triangulated my emerging finding based on the multiple sources of data collected in this study. Yin (2009) points out that such data triangulation addresses potential issues with construct validity as “multiple sources of evidence essentially provide multiple measure of the same phenomenon” (pp. 116-117). The design of the study allowed me to compare students' judgments on an earlier administration of a self-description questionnaire with their judgments near the time of these proposed interviews. Our subsequent conversations that ensued over the course of my study—conversations in which students were able to modify and clarify previous comments—helped me to ascertain the level of consistency of the data being collected. Parents' narratives were also examined vis-a-vis their children's to explore levels of corroboration.

External Validity

External validity refers the extent to which "the abstract constructs and postulates generated, refined, or tested by scientific researchers [are] applicable across groups" (LeCompte & Goetz, 1982, p. 43). The qualitative nature of this study makes (statistical) generalizability difficult. However, I have included "thick descriptions" of the setting in the findings so that readers could assess potential transferability and appropriateness to their own settings (Miles & Huberman, 1994). Additionally, as Merriam proposed, when possible I attempted to describe how "typical" individual participants were, in order that readers can make comparisons of their own with their situations. Lastly, the narratives and recordings obtained during data collection are preserved unobscured (Miles & Huberman, 1994).

Researcher Subjectivity

I have come to recognize significant correlations between my research topics broadly—conceptualizations of competence and related issues of self-concept—and my history and the inner landscapes they have crafted. In an article entitled "Smartness as a Cultural Practice in Schools," Beth Hatt (2012, p. 10) concedes that her "interest in smartness originally arose through being an 'outsider' in the academy as a graduate student." She structures her positionality as being a White female who grew up in a working class family.

I have endured my own struggles and am familiar with feeling like an outsider as a graduate student. Unlike Hatt, though, my feelings were neither rooted in being White nor female. Rather, they may have stemmed from feelings of underachievement at different stages in my educational and professional development. These feelings were sometimes inconsistent with the evidence suggested and documented in academic transcripts. Although my undergraduate experience at a historically Black college granted me a degree in physics with honors, and I obtained a master's degree in mathematics education at a different institution at which I achieved at high levels, I approached the Ph.D. program with some trepidation and uneasiness. Although I had been out of the classroom, as a student, for a number of years, I had spent almost a decade teaching secondary mathematics at a public high school.

Even though my performance in most graduate courses was fairly impressive, some courses provided, what I considered to be, almost insurmountable challenges. Many of these challenges surfaced in courses the comprehension of whose subject matter I was supposed to master. The wages of my persistence, though, were largely internal assaults on my self-concept. Any feelings that I had as an outsider arose more from questions of competence and perceptions of competence—estimations of my competence and perceptions of others' perceptions of my competence, and the associated threats of each. So, after a number of semesters of uncertainty complicated by multiple research interests, I began to pursue in this proposed dissertation, research that focuses not specifically on "smartness," but on competence—its older sibling.

Ralph Cintron (1997) maintains that these inclinations are "emotional intensities (p. 6)," that originated long ago. Furthermore, he argues that we become magnetized by certain fields and fieldsites as a result of these intensities. Cintron concludes that our analyses "are deeply embedded in the intensities of particular feelings that over years have not dissolved but have become, to a significant degree, the core of a worldview, an interpretative frame, a heuristic (p. 6)." As Cintron emphasizes the connection between life experiences and fields of works and their sites, I highlight my struggles with competence and feelings of competence, and acknowledge their contribution to my interpretive frame.

Researcher Bias

Researcher bias poses a threat to the validity in research studies. Researcher bias often results from selective observations, recording, and reporting of information. It threatens to allow personal views to cloud data interpretation. Miles and Huberman (1994) maintain that such bias usually arises from either the effects of the researcher on the case or from the effects of the case on the researcher. My own potential biases stem from my role as an educator and particularly as an African American educator.

My positionality as an African American educator with teaching experience in a predominately African American high school presents the potential for levels of bias. Also, as an African American, I would like to see African American students of mathematics represented well as a counternarrative to the majoritarian discourse of deficiency that prevails in discussions of underperformance and achievement gaps.

I met these students during the summer of 2011 when I served as a teaching assistant in a graduate course in classroom management for Master's in Arts in Teaching (MAT) students. During that time, these MATs and I provided assistance to the academic teachers of the participants who were enrolled in a summer enrichment program that included a mathematics class. MATs and I had opportunities, in turn, to work with some of the adolescents who participated in my pilot study exploring similar issues of math competence beliefs of a group of African American middle school students. In conclusion, my multiple positions and roles as an African American, as an educator, and as a teaching assistant inspire certain degrees of loyalty that could threaten my research and analyses with bias.

Each of the six chapters that follow offers a portrait of a student participant. These chapter portraits synthesize data from student and parent interviews, participant-generated materials (mathematics autobiographies, mathematics logs, and social knowledge structures) and responses to various instruments [Self-Description Questionnaire II (SDQ-II), Fennema-Sherman Mathematics Attitudes Scales, and the Multidimensional Inventory of Black Identity-teen (MIBI-t)]. A cross-case analysis follows these six within-case analyses. I conclude the dissertation with a summary and recommendations for future research.

WITHIN-CASE ANALYSES

Chapter Four:
TAMAR: Open Skies

Tamar is a young lady who exemplifies a kind of indescribable other-worldliness. This otherworldliness is not merely a quality attributed to an adolescent whose peculiarity one could easily and mistakenly dismiss as simply eccentric—as the green highlights in her hair green might imply. Instead, these—along with the high-top Converse sneakers in the summer—are simply artifacts of the artistry and creative expression that Tamar embraces. Her seemingly unaffected manner suggests an aloofness that might distance her from those seeking her attention. But this is rather the type of tacit invitation she extends to others for them to engage her in less pedestrian affairs than she often finds herself immersed. The calm of her voice and the precision she seeks in sharing her responses reveal as much about her as the content of her responses. My visit to the home Tamar shares with her father and older brother would reveal some of the sources of her otherworldliness and creativity.

Tamar's family, home, and school environments contain a number of intriguing dualities. Tamar's genealogy combines at least two distinct racial heritages. She is the daughter of an African American father and a mother she describes as "Asian." She is the second of two children in her household. Their duplex is located in an area that borders two communities, each undergoing urban renewal. The duality of

Tamar's family and home life also extends into her school community. Like her home, Tamar's school borders two communities burgeoning with economic development. The high school where Tamar presently attends as a ninth grader, was a middle school last year and was where she completed the eighth grade. Local politics and district resources decided to temporarily transform the campus of her middle school into a high school that the middle school would have fed into. It is ironic that her school had on it's wall during the beginning of this transformation: "[Andrew Young Middle School] is not just a school, it is a community that cannot be transferred or replaced." Indeed, her family, home, and school contexts reflect dualities, multiplicities, and sometimes contradictions that converge to form elements of Tamar's multiple realms of experience.

On the occasions I visited the Weston home, Tamar came downstairs to speak with me in lounge pants shrouded in the warmth of a blanket's comfort. I sat at a table in the dining room facing the kitchen. The table had a Bible verse resting on a corner of the table. There was also a candle and incense holders. Slightly above my line of sight was a photograph of Tamar and her brother placed in the corner of a larger painted picture. Musical notes adorned the walls around me. I discovered that her father had sung in a band. And her brother aspired to produce music. I observed a Technics turntable and a dual cassette music player near the table where I sat. I also learned that her father had decorated a cabinet with a collection of animation illustrations. On a flat screen television resting on a book display shelf, he watched an animated series attentively as Tamar and I prepared to converse. On my final visit to the Weston household, I noticed a telescope in a corner of the room where

Tamar and I would speak. Mr. Weston and I noted that this was the eve of the Orionid meteor shower.

As Tamar settled into our conversation she revealed that it was her 15th birthday. Her announcement made it clear that she was well in the throws of adolescence—that intermediary passage between childhood and adulthood. She was also in the transition of starting her first year of high school. As I took my seat and tested my recorder, I imagined the kinds of stories and other kinds of information Tamar would reveal and that I would discover. Sitting near their telescope, I was struck with a sudden awareness. By gazing through the telescope, Tamar and her family could observe and witness otherworldly, celestial phenomena from a distance. Yet, it was my hope to look (and listen) intently within our conversations using various tools and instruments to learn about the hopefully more accessible and introspective world(s) of Tamar's experiences with mathematics and her mathematics self-concept beliefs.

Mathematical Competence Beliefs

Tamar documents some of her beliefs about mathematics and mathematics competence in her math log (Appendix L5). In that document, Tamar reveals fairly routine activities which she views as mathematical, or at least where mathematical connections exist. She includes daily activities (e.g., "walking to school," and "cooking"), leisure and recreational activities (e.g., "listening to music," and "painting"), and personal incidents (e.g., "storing art supplies," and finding her "average of tests"). Tamar includes estimating time, such as in her walk to school, and in gauging when to send a letter to ensure its arrival within a specific window of time. She also lists counting ("how much I spent," and "how many songs") and calculating (finding slope, and "finding out why I failed") among her mathematical activities.

Tamar recognizes the use of ratios and proportions in a number of the incidents she cites. She writes about determining "how much sugar" to use to prepare a dish. She also considers "how much paint to use" in order to achieve a certain hue or effect. Tamar also lists using algebra to determine "how many songs make an hour." She also highlights her use of "percents" in grade calculations and finances ("counting money"). In these listings, Tamar demonstrates her awareness of the connections between some of her most routine experiences with the mathematical understandings that have supported her accomplishments.

Tamar has a history of strong mathematical accomplishments that, many people are optimistic, portends similar academic achievements and success in high school. Her father points out,

> "All through school, she's been a talented student. When she was in elementary [school], she was on the Honor Roll every year, straight A student. I think she scored the highest score in the school about four times on the … [state] test."

Tamar repeated this performance in the eighth grade, achieving the highest score in the school on the state's competency test in mathematics. That year, she scored 897 out of 900 points, only answering one problem incorrectly. Tamar also reports that after her first semester in high school, "I got all A's, and I got placed 14th out of 374 math … students."Despite demonstrating such mathematical prowess, particularly as is associated with grades and achievement, Tamar's description of mathematical competence reflects a conspicuous absence of any reference to good grades.

Although she possesses a record of good grades, she does not view them as criteria or guarantors of mathematical competence. Although she says that she did not expect them, Tamar indicates that her final grades for the fall semester were all A's ("like 90-something"). Tamar feels, in some ways, that she does not deserve the good grades she receives because, "I didn't work hard as much as the other students who actually … got a lower grade than me." When asked about which things comprised mathematical competence, she explains:

> Good grades don't determine how well you do in math. Grades are often, … in general, taken so seriously that many people also abandon their morals for it. Now, good grades don't really determine how good you are in school because you could get a good grade, even though you still didn't try. You can get a good grade just for being—like your teacher having a biased opinion.

Although she does not directly challenge correlations between comprehension and grades, Tamar challenges the weight assigned to grades, especially given the students and teachers whose questionable character may undermine their effectiveness.Tamar appears to establish a personal metric for evaluating her own mathematical competence. She maintains that she expects to get good grades, "nothing lower than a low B." She classifies C's as "just unrespectable." Although she had earned straight A's the previous semester, Tamar characterizes grades from a more recent period modestly: "I think it's fair. … I get high B's. That's fair." It is unclear that the fairness that she addresses refers to the equitability of the grade judgment or to the mediocrity meted to the assessed performance level. Whatever the case, it seems that Tamar's metric of evaluations is more critical.

Tamar describes mathematics as a process, “a[n] accurate way of solving an answer.” She includes in her description of components of mathematical competence the capacity to comprehend concepts, and the ability to model and represent quantities, expressions, and equations: “I think usually by modeling with some type of objects or objects, that’s … the easiest way to really understand something.” Competent students “have to be able to demonstrate what they mean. … They have to be able to demonstrate the solution for a question. Like say for algebra, y = 3x + 6. They have to demonstrate that.”

Tamar’s description of mathematics competence aligns remarkably closely with PISA’s framework of cognitive mathematical competencies. In emphasizing the ability to model with objects to facilitate and demonstrate understanding, Tamar echoes the PISA framework’s endorsement of modeling and representation, and the use of aids and tools. In asserting that students have to be able to “demonstrate what they mean,” she echoes PISA’s endorsement of thinking and reasoning, argumentation, and communication. And as she advances *demonstrating* solutions, Tamar supports problem posing and solving. When Tamar insists on the ability to demonstrate y = 3x + 6, she simultaneously urges the use of symbolic language and operations. Tamar also suggests that students who ask for help or explore tutoring opportunities may develop “a better understanding” of curricular mathematical concepts and, by doing so, may enhance their mathematical competence.

In addition to knowing concepts and solving problems, Tamar highlights, to some degree, effort as a hallmark of mathematical competence. She emphasizes listening and paying attention as particular areas of which students should be mindful. Tamar asserts, “I don’t really think it’s focused upon … how hard you study. It’s just that you do the best to your ability.” Competence, then, becomes a product of effort and ability. If effort and ability result in a grade of 71, Tamar points out that the student could still be a good student, “as long as he did his best.”

Mathematics Self-Concept Beliefs

Tamar’s self-concept beliefs sometimes appear inconsistent with her general mathematical competence beliefs. For example, although Tamar stresses working to “the best of your ability,” she acknowledges her own lack of effort. As she pondered her academic success, Tamar explains, “Honestly, I don’t really put a lot of effort into school like that. I don’t know why, but I just don’t. Basically, I just sit in class, listen, pay attention. And that’s all I do.”

Tamar also attributes some of her mathematical capabilities to her family: “I believe that the reason that I do so well in math—and, yeah, I don’t really put any effort into it—isn’t just ‘cause of my attentiveness. It’s … also because my parents are smart.” Interestingly, Tamar’s father attests, “My uncle traces our family history back and he [has] told us that our family was always talented in math.” Despite what may be a familiar narrative of familial ability, Tamar seems to equivocate in endorsing natural ability as a component of mathematical competence. Although she recognizes her parents’ intellect and acknowledges their contribution to her intelligence, she does not explicitly name natural ability as a competence component. Rather, she affirms that “natural ability should not be a component due to the fact not all can achieve the ability; it’s just an advantage.”

Interestingly, Tamar attributes her lack of effort to her "laziness and my own self-confidence … in my answers." Her confidence in her work and solutions prevents her from checking her answers, thereby minimizing her effort and, in her judgment, maximizing her efficiency. Her confidence in her mathematical solutions also stems from the manner in which she wrestles with the concepts in her minds: "In this particular subject I think I do well 'cause not only do I … physically grasp it, but I … really think about it mentally."

In early conversations with Tamar, she reveals that she especially enjoyed algebra and related topics including circumference and area. She offers the following explanation: "I think [the reason is] the fact that there's a variable in there that could be … like possibly anything, and the fact that you have to calculate it … just to like get the accurate answer." In those conversations, Tamar relates pondering and enjoying mathematics, even in her leisure time:

> I think of math more than my other subjects in general, like when I'm bored, think of something, like count the stones … when I walk to school I count how many steps or whatever and estimate how long it would take me to get there and back with a friend next to me and by myself.

Tamar also displays her affinity for mathematics through her pursuit and appreciation of patterns and her manipulation of numbers. She explains:With the clocks, what I would do is … I would be like still up late at night I would like look at the clock and stare at it for a while. It would be like 2:34 and what I would do is I would … kind of manipulate the numbers to make each single digit.

Tamar would execute mathematical operations, such as addition, subtraction, multiplication, and division, to produce in increasing order the natural numbers less than ten (1, 2, 3, … 9). She would go through a similar exercise with her "favorite time of day" which is 6:23: "I like how it completes the 6 by itself; like 2 times 3, that's 6; and the 6 is right there by itself. … So, it's like 'Ah, it's already there!' It excites me!"It is perhaps this affinity for mathematics that helps to fuel Tamar's inclination toward independence and her motivation for efficacy. These attitudes and behaviors are reflected in the following exchange:

Researcher: Who helps you when you're having trouble in mathematics?

Tamar: No one.

Researcher: No one helps you or you don't find yourself having trouble in mathematics?

Tamar: No one helps me.

Researcher: Okay. Do you seek help if you're having trouble, or is there no one available?

Tamar: No. I just prefer to do it by myself. Like if I don't really get it, I'll try harder to really get it. I'll probably try to look into it more or just re-read until I remember the rule.

Her initiative and agency—along with less than favorable impressions she has of a number of her mathematics teachers—makes it easier for Tamar to forego seeking assistance from her teachers or peers, in most instances: "They don't really necessarily tell me to do it a certain way or anything. They don't really tell me what to do. I just do it."

Constructing Competence

Exchanges with Tamar suggest that the ways through which she constructs her mathematics competence and mathematics self-concept beliefs include engaging in social interactions with significant others, positioning and being positioned by self and others, and developing identities and participating in identification. The social interactions that Tamar describes primarily center on her teachers, family, and peers. It is with respect to these various groups that she positions herself and those around her. Tamar develops different aspects of her multiple identities in a myriad of ways and performs various acts of identification.

Teacher Interactions. Tamar's interactions with her teachers are featured prominently in her expressions of her competence and self-concept beliefs. Tamar's views of the mathematics teachers she has had are relatively unflattering. About her current teacher Tamar says, "She's just there. She's like a lamp or a table. She just … gives us our work, like 'Do your work.' 'Don't talk too loud.'" Tamar also alleges that many of her teachers "could not keep class going," and talked "too much … about something completely not related to math."

Tamar's detachment from her teachers and the environment some of them manage is more understandable given the classroom contexts she recollects. She remembers feeling overlooked and ignored as she made attempts to respond to teacher prompts by raising her hand: "They want to pick someone who probably wasn't listening to see if they can answer the question." In this instance, a failed teacher attempt to manage the environment by putting unsuspecting students on the spot may have the unintended consequence of discouraging the participation of perhaps more enthusiastic students. Although she mentions being challenged to participate more in classroom activities, Tamar typically declines these invitations.

Tamar recalls an eighth grade incident:

> It was eighth grade. I had a 99 in that class. He said, "Just that one point, if you had participated." And I really did not want to, so I was like, "You can have that one point." But it still annoyed me that I only had that 1 point missing; I had 99."

Tamar ultimately believes that "as long as you grasp the concept of the current lesson being taught, and you can do work without any … struggle necessarily, participation doesn't really matter." These negative perceptions encourage the type of independence that Tamar typically demonstrates in classroom settings.Other teacher behaviors, dispositions, and expectations effectively discourage Tamar's participation. She states, "Some of my teachers … I really don't feel as though they can necessarily help me, if I ask them." Tamar mentions specifically a teacher whose tone "gets a bit more aggressive," while explaining concepts to her. Tamar also recounts that her finishing her assignments quickly and not spending time reviewing her work, prompts some teachers to "think I'm going to fail, if I continue to do that."

Tamar's father expresses his own concerns about Tamar's interactions with teachers and the potential consequences that result from them. Mr. Weston reports that Tamar would often have completed her work by the time the teacher had finished explaining to the class. He maintains that on occasions teachers were overly and perhaps prematurely critical: "A lot of times when [Tamar] knew things …, a lot of them still tried to find fault with what she *didn't* know." Mr. Weston suggests that these teachers seemed to emphasize deficiencies, rather than highlight strengths in assessing Tamar's capabilities. He further asserts that some teachers saw Tamar "as being sassy, and smart … when she says she knows it already." Mr. Weston notes that some of her teachers would sometimes group her with others, "so she could help the other students." Although, incidents such as these cast in great relief Tamar's ability in relation to many of her classmates, they likely failed to offer her the kind of reassurance a developing mathematics self-concept could appreciate.

Unfortunately, most of the reported interactions and exchanges with teachers help push Tamar in the direction of the independence that her mathematics ability already allows her to possess. Instead of finding relationships with teachers that were accessible, inspirational and invitational, Tamar has grown accustomed to ones that are remote, discouraging and adversarial in nature. She is able to detach herself from both teachers and classroom environments, yet remains fairly engaged in mathematics—particularly mathematics for her own amusement. Her predilection for mathematics is dwindling, though, to focus more on her personal pursuits than on curricular cannons. Between the first and second interviews with Tamar, the attention she gives to curricular mathematics and her intrinsic enjoyment of it undergoes a shift. Initially, she reports thinking "of math more than any other subject," including "when I'm bored." In other words, she thinks of mathematics *just for fun*. In the second interview, however, Tamar reports enjoying mathematics less than her other subjects: "Well, the class now we don't really do anything necessarily, we just we're in there, so I feel like it's just a class. Nothing is going to really happen soon[er] or later. It's just class." The affective shift evident in her discussions is a mechanism that Tamar uses to manage her constructions of what [curricular] mathematical competence is, and to her own mathematical proficiency and self-concept beliefs. This affective shift appears to be catalyzed by cumulative interactions with some of her teachers.

Parental Influences. Tamar's views about mathematics, its relevance, and her understanding of her own mathematical ability reflect the influence of her interactions with her parents. Tamar's father, Mr. Weston, recognizes her ability and assumes some responsibility for its strength. Mr. Weston recognizes his daughter as a "natural leader" who has demonstrated to her teachers and others that she is "very confident." He describes Tamar as an "inquisitive kid" who is "smart in all subjects." Mr. Weston ascribes to her a "natural [mathematics] ability." He indicates, "I was like that too," that is, *naturally* mathematically inclined.

In some ways, Mr. Weston credits his parenting and his mathematical inclination for Tamar's success in mathematics. He points out, "When Tamar was younger, I was one of the people who taught her how to do math." He indicates that he sought homeschool programs for Tamar and her brother. Mr. Weston maintains that many of his efforts occurred well before elementary school so that they could "be ahead when it comes to math and stuff, because I felt like that would be important for them when they get older—to calculate mileage and stuff like that."

Mr. Weston invokes narratives of his own ability and that of other family members. He notes, "All of us went to college," including his grandmother, mother, aunt, uncles, and cousins. He notes that his sister, Tamar's aunt, is a scientist who "has always been good at math." One of Mr. Weston's cousins "scored a perfect score [on the] SAT test. Mr. Weston shares these types of achievements with Tamar and her brother in order to inspire them. He tells them, "It starts with the parents. So, I let them know I was good at math too. And I let them know it was spread to them." Tamar adopts the narrative that she and her brother inherited mathematics facility from her parents. She revoices this belief when she attributes some of her success in mathematics to the fact that her parents had also done well in mathematics.

The nature of the dynamics of Tamar's interactions with her parents is evident in her responses in interviews and on the Father and Mother subscales of the Fennema-Sherman (1976) Mathematics Attitudes Scales. Tamar's responses on the Father scale (Appendix N1) appear to suggest a degree of ambivalence. She chooses a "neutral/uncertain" response for seven out of the twelve items. She chooses the neutral/uncertain option for prompts such as "*My father thinks I'm the kind of person who could do well in mathematics*," "*My father has strongly encouraged me to do well in mathematics*," and "*As long as I have passed, my father hasn't cared how I've done in math*." Tamar's choices might suggest either that she believes her father is disinterested and possibly uninvested in her mathematics competence and achievement, or that she is uncertain of the level of his interest and investment in her exploits in mathematics. On two of the occasions on which I ran into Tamar, her father was present to support her. One was at the Channel the Challenge closing summer program, where Tamar had earned awards. Another was almost a year later, when Tamar completed her eighth grade year and was being recognized by the school, along with other students, for her exceptional performance on the mathematics portion of a state standardized examination. So, it is surprising to note Tamar's neutral/uncertain response to "*As long as I have passed, my father hasn't* *cared how I've done in math*." Perhaps more inconsistent is her "somewhat disagreement" with the statement: "*My father has always been interested in my progress in mathematics*." It is possible that Tamar feels that because of the history she has already established and her family's legacy of mathematics proficiency, her father does not feel the need to engage her as much in regards to her progress in mathematics. She may understand her competence and her progress both to be benignly presumed by her father.

Tamar seems more certain in her responses regarding her mother. For the same questions (different order), Tamar responds with about half as many (3 of 12) neutral/uncertain responses for her mother (Appendix N2) as she did in regards to her father (7 of 12). She "somewhat agrees" that her mother "*has always been interested in my progress in mathematics*," and "*has strongly encouraged me to do well in mathematics*." In either case, Tamar's choices on the Fennema-Sherman Mathematics Attitudes Scales implies that she finds these two statements more descriptive of her mother than her father. Perhaps, Tamar feels that her mother demonstrates more interest in her progress through the encouragement she receives from her. In this light, it is understandable that Tamar "strongly agrees" that her mother views her as "*the kind of person who could do well in mathematics*." More specifically and personally, though, Tamar indicates that she "somewhat agrees" that each parent thinks that *she* "*could be good in math*." Her responses to these Fennema-Sherman subscale items indicate that Tamar trusts that her parents are familiar with her mathematical talent and are generally supportive of her ability.

Peer Influences. Much about Tamar can be gleaned from how she describes her interactions with her peers. The contradictory nature that she assumes and characterizes herself as is manifested in these discussions. Tamar's seeming contradictions and paradoxes also make her present disposition and temperament more illusive and difficult to describe. Tamar also shares instances of peer network closeness and distance with similar coolness/unaffectedness.

Tamar's self-description as being "contradicting" is apparent in her comments about herself and her interactions with her peers. She claims to be both "introverted," and "extroverted" in her first social knowledge structure (Appendix J9). She attempts to resolve this paradox for the interviewer by noting that she is an "extroverted introvert." Tamar simultaneously claims to be "very friendly" and "not really that into social interactions." She explains, "If I have to be social, I will. And I'll be very friendly." In another instance, she clarifies: "I'm very friendly. But I also don't like to be near people because, frankly, they annoy me."

The nearness to people that Tamar mentions could be understood both literally—as in proximity—and figuratively, as in closeness. Tamar recounts what became a recurring incident in her mathematics class:

Tamar: My friend—we had like a test on it—so my friend said in front of the class, "I'm going to sit by Tamar," just like during the test, so he could get the answers, too.

Interviewer: And that started to happen a bit more frequently?

Tamar: Yeah. And I really don't like all the attention. I don't really like to interact with my classmates, like that.

Interviewer: You do or you… don't?

Tamar: Yeah. I don't.

Interviewer: Well, I imagine especially during a test.

Tamar: Well, that's just like in general.

Tamar insists that she is not only troubled by the peers who hope to obtain mathematical solutions from her, but she is unsettled all the more by the attention she feels their expectations bring. Tamar appears at least as uncomfortable with the attention devoted to her highlighted competence as she is with the injustice of being expected to entertain her classmates' unethical requests.

Tamar uses the criterion of mathematics competence to position herself and her peers. She points out, "My class is pretty smart and pretty independent with math stuff. Yeah, they can like get it pretty easily. So, it's refreshing to see that." She continues, "They're all really good math students." In one instance Tamar maintains, "All my friends … [are] basically on the same level as me." For the most part, she assigns a kind of mathematics competence homogeneity to her peer network. Tamar's membership in this group presumes, then, that she to is a *really good math student*. And although she assumes membership in a group of largely homogeneously mathematically talented students, her awards and recognition at school and program ceremonies provide evidence that her mathematics abilities sometimes excel beyond those of her peers.

Despite her aversion to attention directed her way, Tamar recognizes that she is positioned by her peers as a result of her mathematical ability. She believes that her friends think that she is a "pretty good" student of mathematics. When asked whether she and her friends encouraged each other to do well in mathematics, Tamar responds, "I do. *I* encourage *them*." Tamar states that some of her peers call her their mother because she holds them accountable and "won't even let my friends get a B." She suggests that her friends are more "relaxed" and "lenient." Tamar implies that they appear a little less concerned about their own mathematics achievement indicating that "they slack off more than me in my class."

Tamar also recognizes that she may be more mathematically motivated than a number of her peers. On the Self-Description Questionnaire II (SDQ-II), she indicates that to a large degree she enjoys studying for mathematics (five out of six on a Likert scale). Although her mathematics self-concept response marks a slight decline (of one) from last year (Appendix O5), Tamar still suspects that her mathematics motivation may surpass that of many of her peers. She alludes to this suspicion in the following exchange:

Interviewer: Do you feel like you're challenged enough?

Tamar: In a sense. In a way. I mean, we're challenged, yeah, but we can go up a little bit more maybe. Maybe.

Interviewer: "We can go [up] a little bit more." That's *Tamar*? Or do you feel like most students feel that way?

Tamar: It's probably just me.

After a brief moment, Tamar distinguishes with some equivocation that there is room for more challenges from her mathematics curriculum and instruction. At the same time, she recognizes these feelings may only be hers.

Identity, Identification, and Positioning. In addition to the various types of academic and social positioning in which she engages and participates, Tamar also shifts her exchanges with peers in the direction of becoming slightly more interpersonal and interactive. Such positioning and interactive exchanges help Tamar to foster and maintain an identity as a capable and skillful doer of mathematics. Tamar is consistent in her self-description as both "student" and "artist." She finds few opportunities in her scholastic experiences thus far to reconcile these different aspects of her self. She also identifies herself as a "learner" in the first social knowledge structure, and as a "knowledge seeker" in the most recent SKS administration. In a sense, Tamar foregrounds her identities as student and artist. As a student, Tamar seeks knowledge. As an artist, she attempts to represent it. Her identity as an "artist" and as a "creative" individual helps makes her appreciation of the elegance of patterns, symbols, and models—which are essential in establishing and extending mathematical understanding—all the more reasonable.

Gender Ascriptions. In addition to the various ways Tamar identifies herself and others, she exhibits sensitivity to gender assumptions and biases. She offers mainly neutral responses on the *Mathematics as a Male Domain* subscale (Appendix P) of the Fennema-Sherman Mathematics Attitudes Scales. Items that garner Tamar's neutral/uncertain response include ones such as: *It is hard to believe a female could be a genius in mathematics*, *I could trust a woman just as much as I would trust a man to figure out calculations*, and *I would have more faith in the answer for a math problem solved by a man than a woman.* The single item on which Tamar responds emphatically and without equivocation is "*Girls can do just as well as boys in mathematics*," to which she "strongly agrees." Tamar fairly abruptly notes that this line of questioning "is kind of sexist. This whole thing is kind of sexist." Her objection is largely leveled at the language of the subscale items and to the presumptions about ability that these items intend to interrogate. When asked why she responded neutrally to most of these items, Tamar indicates that either gender is vulnerable to mistakes in mathematics: "Well, it's mostly pertaining to gender, so you know, I really don't think gender counts for anything. A girl can be just as bad at math as a boy. You could make 1 + 1 = 3 or whatever, like that." Interesting to note in her statement, though, the positioning of the male as the point of comparison for such fallacious mathematical and questionable mathematics competence.

Tamar makes peculiar gender ascriptions of her own that reflect inconsistency. In her social knowledge structures (SKS), Tamar identifies as an "artist" and attributes a positive valence to this descriptor. Her first SKS is distinguishable in that it also contains the associated positive self-description as being "creative." Within this SKS, Tamar connects the "artist" descriptor with the female icon, yet connects the "creative" descriptor with the male icon. When called to clarify these ascriptions, Tamar responds, "I can't help you on that. 'Cause, honestly, I don't know what I was thinking." Also, in the second SKS (Appendix J10), Tamar connects the positive self-description as an artist to the male icon, shifting her initial gender association. Although Tamar may be unable to explain some of her choices, some of her transforming ascriptions may simply be attributable to the developmental nature of adolescence and to the transitory nature of boundaries of concepts, such as gender, competence, and justice.

As her gender associations—and the things that influence them— are not fully explicit, Tamar's connection to her mother brings into question the nature of her identification with her mother. Tamar is the only female in her household of three. She lives with her divorced father and her brother, each of which is characterized as mathematically proficient. When I question Tamar about her mother's attitude toward mathematics, she responds, "I'm not really sure, 'cause we don't really talk about [math] a lot. We mainly talk about what's happening in our lives at the moment. Then, we go into more social justice arguments in economics and … politics." Tamar states that her mother "expects me to do my best. And with that … she expects me to make 100's [and] A's." Tamar notes that she is also aware that, although he hardly articulates them explicitly, her father maintains high expectations for her in mathematics. She distinguishes, though, that he is "more focused," on the progress of her older brother who "wasn't doing well in his classes, and he was missing class and stuff." Dynamics such as these possibly make Tamar's gender ascriptions more salient and may contribute to the ways Tamar identifies with her mother.

Despite the high academic standards and expectation her parents appear to have, for the most part Tamar resists setting expectations for herself in mathematics. She affirms:

> I really don't keep expectations for myself. Because I feel as though if I do, I will most likely … just limit myself and don't … set an open sky. … So, if I learn myself, I'll only get to a certain

> point, and after that I'll quit. However, if I don't put any expectations on myself, I could do whatever I want.

Tamar asserts, "I leave my sky open. I leave it open for possibilities." The following exchange suggests that Tamar prefers the freedom that she sees in avoiding imposing expectations upon herself—those of others or, even, her own:

Interviewer: What do you think [about] the more immediate people around you – *your* expectations of you in math and *their* expectations of you in math? How do they compare? Do you think that other people leave the sky open? Or that they have particular expectations of you, and all those expectations are the same that you have? Or do you … feel like they are different?

Tamar: They don't really set expectations for me.

Interviewer: Okay.

Tamar: Yeah, so that's good.

Interviewer: It's good for you that they don't set expectations?

Tamar: Yeah.

Interviewer: Okay. Why is that? … Why is that good?

Tamar: Well, really, my whole mindset on expectations, I think if you don't set any, you can avoid being disappointed and what not.

Despite her resistance, at different moments in our conversations, Tamar acknowledges the expectations from her parents that she excels in mathematics.

Both of her parents refer to their own mathematics proficiency as part of their rationale and justification for their expectations of Tamar. Her father makes it a point to distinguish a proud legacy of mathematical skill and ability. Tamar explains that she believes her mother has such high mathematics expectations because "I have [done well] before, and she [Tamar's mother] says that *she's* smart. And so, in the knowledge, your intellect comes off your mother's side." In the face of her awareness of both her parents expressed mathematics proficiency, Tamar's trusts that her mother's contribution to her intellectual and especially mathematics side is more significant ("I read a study that said most of the time intelligence comes from your mother"). Therefore, Tamar is inclined to believe that mathematical—or more broadly, intellectual—capacity is generated from a maternal source, and thus assumes a feminine association.

Racial Identification. Tamar's racial identification also has implications for the ways she views her mathematical ability and the ways she believes her ability is viewed by others. Tamar's multicultural background makes the relationship between her conceptualizations of mathematical competence and her mathematics self-understanding. Her father is an African American. Yet, Tamar identifies her mother as "Asian." When asked how she identifies racially, Tamar also answers "Asian." It is noteworthy that although her father describes Tamar's mother as Korean *and* Puerto Rican, in her own racial self-classification Tamar references neither her African American nor Latina heritage. Perhaps just as interesting to note is that when asked how he believes his children identify racially, Tamar's father, with whom she and her brother live, answers in a definitive and straightforward manner, "as Black. But they also know, too, that they are multiracial."

Tamar expresses her awareness of Asian stereotypes and reveals that she has been targeted by these prejudices. She recounts that when she got a 100 on a test when she was in the third grade, some of her peers attributed her success to her Asian heritage. She makes the following claim:

> I've noticed … only the African-American students actually say something. Like they'll say, "Oh, you're just smart because your Asian." However, the Caucasian children, … I think the fact that their parents talk to them more about more races and stuff, they're aware of how I feel and others do. So, … they avoid that whole thing.

Her claim identifies her African American peers as the more likely perpetuators of prejudgment. She also presumes Caucasian families have more discussions about races, and are more racially sensitive.Partly as consequence of experiences such as these and her interpretations of them, Tamar feels the need to suppress aspects of her Asian heritage. She explains:

> I give more pride to my Asian side because it's not really expressed. Well, in this society, I can't really do it. … I have to limit myself to speaking English because, … that's all the people can speak over here mainly. And they don't really take the time to actually learn another language or try to at least understand a bit.

Tamar presumes that American culture is not particularly receptive to Asian culture(s). Also, she is apprehensive of Americans appropriating and exoticizing Asian culture(s) in the manner that Korean pop singer/performer PSY has recently been celebrated. Tamar alludes to how people often jump on a bandwagon of perhaps temporary interest. This interest, however, is often a superficial curiosity that fails to inspire the depth of investigating and exploring other aspects of cultures.Not only is Tamar aware of the how people can uplift selected aspects of particular cultures, but she is also sensitive to how individuals, or groups of individuals, are able to denigrate characteristics attributed to other cultures. Tamar's father, Mr. Weston, relates that Tamar and her brother were introduced to the sting of racial slurs in the latter part of elementary school. Mr. Weston describes the incidents as " a shell shock for them." He relates that Tamar and her brother would cry after coming home recounting, "[Someone] called me the N-word. What's that mean?" Mr. Weston detected that his children sensed that it was not a good thing to be called and attempted to explain the extent of its derogation. It is not clear whether Tamar's sorrow stems from being identified with African Americans or from the negative stereotypes and stigmas associated with that identification, or some combination of the two. Whatever the case, the fact that Tamar does not explicitly assume an African American identity does not insulate her from the pernicious assaults based on the racial ascriptions of others.

The Sky's the Limit

As Tamar matures into adolescence, she continues to negotiate dual, and often multiple worlds. She travels along the border between youth and adulthood. Tamar's reality extends into regions in which she endures scholastic experiences with curricula, and explores the interests she believes to be her avocation—graphic arts, and language education. Yet, there is hardly a place where Tamar's navigation within a collection of personal worlds is more salient than in the subterranean, often clandestine, space of racial acknowledgement and discourse. As the child of an Asian [American] mother and an African American father, Tamar inherits both elevated and derogated presumptions of mathematical abilities.

Rather than to succumb fully to the expectations of others, based on these presumptions, Tamar is deliberate in her attempts to establish her own mathematics identity. Although she is generally careful not to name expectations, when pressed to share the ones she has for herself, Tamar chooses to speak in the third person:

> I expect [Tamar] to get good grades, like nothing lower than a low B. I would not accept any C's … . I expect her to really try to beat her procrastination and really just get her work done before the procrastination sets in.

Although these expectations appear fairly modest, they are not necessarily goals. She is cautious not to craft a ceiling. Rather, she frames a floor—a minimal threshold of ability and tolerance. Perhaps, she does this to be faithful to her philosophy of *keeping her sky open*. Tamar chooses to escape—as much as she can—the boundaries of expectations potentially based on racial or other categorizations. She prefers the freedom from the limits of expectations that her academic and mathematical competence provide. And though, Tamar has established an already impressive history of mathematical competence, it is important to consider the things we allow to threaten her open skies with more foreboding forecasts.

Chapter Five:
OMARI: Into the Zone

During the summer of my engagement with an academic enrichment program, I saw a number of the student participants and I remember seeing Omari on several occasions in passing. He was distinguished at the time by his faux-hawk hairstyle. I would come to formally meet him, though, a couple of months after these casual passings. At the time of my first interview with Omari, he was staying about 150 miles away from the city with a family friend for the summer. Omari's family agreed that I should meet and interview him at the home where he was staying for the summer.

As I drove to our meeting, I was struck by commonalities that were a part of both Omari's and my life. I was familiar with the two-lane highways, and railroads that connected farms, and communities outside his town. The rural nostalgia of cornfields, cows, and tractors was also comfortably familiar. Even the name of the county 45 miles away from the home where we met was identical to the name of the county where I grew up.

Along my three-hour journey, I reflected on the time I first interviewed Omari and met his father. His father, Mr. Knight, had driven him about fifty miles to meet me at a regional mall. When we met, I was surprised to discover that Mr. Knight was a White man. I remember casually meeting him a month before at a program orientation. He introduced me to his African American wife and a younger son. I learned later that they adopted both of their sons. Although he explained that he had a son in the enrichment program, I did not meet Omari then.

When I met Omari and his father at the mall, we searched for a place to talk. The food court was not conducive to us recording a conversation. Music was piped through the mall airways and benches were sparingly placed in uncomfortable settings. We hoped for and sought more hospitable accommodations outside. Yet, we were disappointed that the prospects that we anticipated failed to appear.

As none of us was familiar with this shopping center, our journey seemed aimless. We grew optimistic as we spotted a mall security utility vehicle patrolling the parking lot. I thought that, perhaps, I could hail the vehicle and ask if there were outside benches where we could have our conversation. Despite my attempts, though, to the vehicle in the distance, we went unnoticed.

I cannot remember who offered the following scenario. I *do* remember the sadness of its "truth." Omari's father and I entertained the idea that security would have been more attentive and immediate in its response, if Omari and I feigned assailing the White man in our midst. Our laughter grew more serious as we began to understand how little we were actually joking. The implications became sobering with the reality that Black males are often criminalized. As such, a number of parents of Black children, especially male children, feel that their children should be prepared—or worse, socialized—not to be surprised when they face such treatment. Interestingly, Omari's father confided that he had tried to prepare Omari for such possibilities. He and his wife, though, were concerned about his limitations. Mrs. Knight has shared: "I love my husband, he's a good father but he can't teach him how to be a Black man in America."

What were the texts of the conversations Omari's parents had with him? What were the contexts? How would Omari's father translate his concerns for his son to him? How would Omari interpret or come to understand his parents' concerns. Would he appreciate them? The confluence of the murkiness of race and the certainty of judgments based on racial classifications was complex. How would Omari's experiences with race intersect with his experiences with mathematics? Through what filters would he come to characterize mathematical competence? These were among the questions that intrigued me, as we found—or, rather, created—a place to sit and talk.

Mathematical Competence Beliefs

Most of Omari's mathematical competence beliefs are connected to his ideas about what is mathematical and to his various personal experiences with mathematics in the various configurations of schools he has attended—including public, parochial, and private. He incorporates motivation and effort into his conception of what comprises mathematics competence. Omari also emphasizes that the ability to balance working independently with working collaboratively through asking and answering questions also signals competence.

Omari's perspectives about mathematical competence are related to his views of what is mathematical and can be interpreted through the lens of his career aspirations. Omari accepts that his educational journey will be filled with an abundance of mathematics and science courses. He aspires "to get into Harvard University and … go to the engineering school there, [and] become a mechanical engineer." After finishing his studies at Harvard, Omari intends to design rollercoasters.

In his mathematics log (Appendix L4), Omari recognizes mathematics and physical science concepts embedded in many of his primarily leisure summer activities. For example, several of the incidents (witnessing fireworks display, playing roller coaster video game, driving around a parking lot) to which Omari refers incorporate aspects of spatialization, coordinate geometry, and plotting (or anticipating) trajectories. In considering playing soccer Omari "tried to graph in my mind the easiest way to bend the ball into the goal." He acknowledges that his activities involve physical science notions of "force and motion." The activities that Omari documents, along with the thoughts about mathematics he assigned to them, are not surprising in light of the his interests in mechanical engineering and rollercoaster design.

Omari also contemplates the nature of mathematical relationships. He applies concepts of uniform motion to "calculate how long it would take to get to a party at 35 mph on average" after leaving an hour late." He mentions comparing and analyzing data to explore relationships. At a pool party, he examined the "trajectory of splashes" and compared it to the "weight of the person and how far their splash can go." He also discovers when playing a video game with a friend that "the terminal velocity of a bullet in real life is still slower than the bullets in the real game" and concludes that the game depicts it in a way that is "unrealistic." Omari also uses mathematics to argue about "how much I never get the TV." He explains that he "[compares] the one person's time to mine in a fraction [of] hours of TV over hours in the day."

Omari's log highlights his interest in "geometry and shapes." Omari indicates that he analyzes relationships among geometric shapes and spaces. In viewing a popular summer movie, he ponders "how it is mathematically possible that a moose could fit through a small door." He considers and compares approximate areas and volumes. Consistent with his consideration of capacity, Omari "tried to plan a clear route for the car to go between to [sic] trucks … knowing … how much space I had, and how much space the car took up."

Much of Omari's conceptualization of mathematical competence springs from his personal experiences with mathematics in various academic setting configurations. Omari has attended independent (Montessori) schools from kindergarten through the second grade; public schools, from third to fourth grade; and a private (Catholic) school in fifth grade. He attended a public school in sixth grade, followed by returning to a (different) Montessori school for his seventh and eighth grade years. He is now preparing to begin his first year of high school. Omari's mathematical competence beliefs reflect his consideration of transitions and differences in his mathematical experiences in multiple academic settings.

Omari's conceptualization of mathematical competence centers on an understanding of mathematical processes. Omari describes "Math Seminar" as "one of my favorite things" about the Montessori school he attends. Math Seminar is a weekly recitation where students work, independently then collaboratively, to figure out problems assigned by the teacher days earlier. Omari explains

> They're word problem questions that have to do with what we're learning in math at that certain time or what we should have already learned. We have to find a way to work them out. You cannot talk to anybody. You cannot talk to your parents about it; you cannot talk to anybody. You have to work it out on your own.

Omari further explains that students argue the significance and validity of answers they propose: "We have to show our work, and then debate what our answer means. We never get the answer."The Math Seminar procedures of cogitation, explanation, presentation, and argumentation feature prominently in Omari's formulations of mathematics competence. These procedures coalesce into a cohesive amalgamation—a "process," that Omari often emphasizes. Omari conceptualizes mathematics broadly as "the *process* of adding, subtracting, multiplying, or dividing out numbers." Consequently, he views the Math Seminar as an occasion to attend to process over product.

The fact that the teacher/facilitator of the seminar does not give students the answer expands the focus from determining a mathematical solution to understanding and engaging in a process of mathematical discovery or implementation. Omari asserts, "They focus on the process—you knowing the process—not getting the right answer at the end." Omari explains that as classmates present and argue their respective solutions, "everyone looks at the process they did." Again, the students' focus not only on the final answer, but also, more importantly and specifically, on the comprehension and navigation of mathematically sound processes. The dynamics described also likely decenter the locus of authority from the teacher and relocates it more often among the students during Math Seminar.

Omari is mindful of a person's motivation and determination as a dimension of their mathematics competence. He stresses, "If you actually think about what you are doing, … you can do anything you want to. Omari emphasizes that this ability to perform and achieve is determined "not because of your race or not because of who you are." Furthermore, Omari affirms, "Nowadays there is sexual orientation also. That doesn't matter. … It's because of what you know you can do and how hard you want to get to it." Omari links individuals' efficacy with their drive to achieve and persist.

Omari believes that he is able to discern an individual's efficacy, motivation, and effort by observing the expression of their countenance:

> I can just see that face on certain people and I know that they're trying. So if…and you can also see when they're not trying—like if they want to get it done really quickly. So, they aren't putting enough effort into it. So they're trying to do their best. They're not just trying to get it enough where they can turn it in and get their little check. They're trying to actually learn something. And they're doing their best to really… learn the concepts and remember.

In his statement, Omari suggests that competent students of mathematics are ones who "learn" and "remember" concepts. Also, they work hard by "putting enough effort into it." Since these students' motivation is to understand rather than simply to achieve a certain grade through expedient activity, their efforts tend to exceed the minimum amount required to secure the approval of a teacher or evaluator.Although Omari supports the idea of natural ability in mathematics, he still emphasizes the importance of effort:

> I believe if you have natural talent you still need to put effort into it to do well in math. I believe that doing well in math differs for different people. … Some people, they might have not had that natural talent that I was talking about. But they still put effort into it.

Effort produces competence and therefore becomes somewhat of a necessary prerequisite for mathematical competence. Omari describes a student at his school whose uncanny facility with numbers and simple mathematical operations he and other classmates admired. Despite being able to compute and figure numbers, this "Human Calculator," as he was called, "did not put in any effort." Consequently, the student had to attend summer school. Omari reflectsHe could have done so much better, but when you start getting into algebra it's not about those facts. It's about the process, and so when he didn't pay attention to those processes or anything. He started to go down and down until he finally started failing.

Omari maintains that attention to "those processes" and efforts to comprehend and execute them prevail in the establishment of mathematical competence.Omari suggests that effort should be thorough and sustained. He affirms that in mathematics, "you have to be calm and sit down and go through your process without trying to rush and write down numbers." Omari points out,

> It's not your best effort if you can do the math lesson in an hour. It's your best effort if you can sit down and thoroughly go through your process and explain it, … [not] trying to get it done before the math lesson.

In addressing potential reasons for students struggling with math, Omari offersNow, that does not mean they're not good at math or they're not good enough to be in math. … I just believe that they need more time. Everyone can learn it, I believe. Some people just take more time for the processes to sink in and everything or more time to really take in everything.

Clearly, for Omari, speed is neither a prerequisite for, nor evidence of the efforts one exerts to establish mathematical competence. Omari emphasizes the primacy of effort, even over test scores, in the following statement: "You may not get the best grade on the test, but she knows you're putting effort [forth]. So that's doing well." It is not clear from Omari's comment if "doing well" in mathematics is the product of an individual's efforts, or of the teacher's acknowledgement and recognition of those efforts.Omari enjoys the responsibility and autonomy he experiences in his academic setting. In speaking about "the Montessori way," Omari comments how "it really works for me." According to Omari, Montessori schools give students more time to complete tasks and insists on student learning and participation: "[In] public school, they give you a choice if you wanna learn. … If you're put in Montessori school you're gonna learn whether you like it or not, whether you know it or not."

In Omari's experience, he and other students are often allowed to "[choose] what you wanna do for that work cycle," "move at your own pace," and "check your own work." This level of autonomy is entrusted to students whom the teacher considers "responsible enough to teach ourselves math." Students teaching themselves generally refers to them progressing with curricular modules largely of their own initiative at their respective paces. Students have the option of redoing many of the assignments. When asked who determines if a student needs to redo an assignment, Omari responds, "The student determines it. Our teacher believes ... that you get the concepts down, and after a while you're tested on those concepts." Omari also explains, "When we complete a chapter, we get to determine when we finish a lesson—when we think we've got the concept down." In this setting, authority is shared with students in the construction of their mathematics competence. This type of authority and autonomy are woven in the fabric of competence for Omari.

At the same time, though, Omari implies that the teacher maintains a role as an essential, if not ultimate, arbiter of competence. It is *her* approval which must be sought and garnered. Omari stresses how significant it is that teachers are able to evaluate a student's knowledge:

> They make you know it before they test you on it, so they know you know it. So, even if you don't pass a test she still knows you know it. Of course she'll make you take the test again, but she knows you know the concept.

This teacher's authority is implicit in Omari's explanation: "All I need right now is to get this concept down into my head. And once I have it down, I can just show her and then she'll accept it." In his classroom, competence is such that it is witnessed and accepted by the teacher. In this way, the authority of teachers is even more final than that suggested of classmates in assessing the progression of students' competence.The distribution of classroom authority among students and teachers is evident in the degree to which asking and answering questions is a part of Omari's profile of mathematics competence components. Omari explains that during the Math Seminar part of his class, the teacher does not give students answers. Students must, instead, ask questions to guide their inquiry:

> You have to ask questions to inquire it, so they'll think of it: "Oh, I did this wrong." And then they'll look at the board and then they'll do it. But you cannot say, "You did that wrong." ... You have to ask them a question.

So, classmates work individually and collectively through asking and answering questions among themselves. Omari points out, "You have to inquire, so it gets their minds jogging." Whereas being able to propose solutions certainly becomes a hallmark of competence, for Omari, the capacity to formulate questions and navigate the Seminar process—through discovering, challenging, modifying, and verifying solutions—also evidences mathematics competence.

Mathematics Self-Concept Beliefs

I begin examining Omari's mathematics self-concept beliefs by exploring his academic mathematical history. His mother explains that Omari started Montessori school in kindergarten, when he was around two-and-a-half years old. It is while he was in kindergarten that Omari "first realized that I was good at math." Omari recalls that when he was in kindergarten, second graders were taking a timed test, "I think on multiplication." Omari reports that his teacher did not see him when he grabbed a clipboard and "sat down with all the ... second graders" and worked on the test." According to Omari, "I got about three-fourths done with it. I had done more than some of the second graders had done." The teacher was surprised when she discovered him taking the test and was, perhaps, more surprised by his performance. Omari remembers:

> The teacher said, "What are you doing here?" And she asked, "Did you steal somebody else's paper?" I said, "No, this is my paper." She said, "Are you serious?" And so, she realized then that … I had a bigger aptitude than she thought I did.

Omari remained in the Montessori setting through the second grade. But this incident would come to typify experiences in which Omari would perform at levels beyond many of his peers.Omari's mother, Mrs. Knight, recalls that Omari "learned his math facts quickly" and that "he was always a really good student." His father insists that mathematics "seems to just come to him naturally." He participated in a gifted program at a public school in the third grade. Both of Omari's parents came to advocate for work that was more consistent with Omari's ability during his third and fourth grade years. Despite doing "quite well" in a program for the gifted during both of these school years, the Knight family was disenchanted and disappointed at the disappointing lack of challenge the curriculum extended to Omari. Mr. Knight recalls a conversation with Omari's third grade teacher in which "we told her—probably me specifically—I don't know, but I told her that he needs to be challenged because the stuff she was teaching in third grade, he'd already had."

Both Omari and his mother were frustrated with his fourth grade experience. The gifted component of his curriculum seemed to occur "just one day a week." Mrs. Knight remembers, "A lot of times he was bored and I would say, '[Omari], do you wanna go to some kind of math camp, or whatever?' And he would say, 'Oh, that'll just put me *another* year ahead of everybody else.'" Here Omari began to feel an uncomfortable burden associated with his intellectual acumen. Mrs. Knight feels that during this time instead of being stretched to accommodate additional intellectual stimulation, he often faced the similar coursework and challenge levels:

> I remember when he was in the … "gifted" program, supposedly. It's like, Why does he get the same work? I don't necessarily think that he needed to be Einstein. But if you're capable, then give him what he's capable of doing. It doesn't mean that I'm trying to push him towards a race to nowhere. I don't wanna give him information for information's sake. But I want him to be challenged … not just sit there.

What his mother views as institutional low expectations may have tempered Omari's academic motivation. During the fifth grade, he attended a Catholic school. As he began middle school in the sixth grade, he returned to a public school. She reports that in the sixth grade "they were okay not turning in their assignments. … I felt like the expectation [other people had] of him dropped—not just for him, but for the whole group." She is most disturbed by the prevalence of low expectations and its effects on her son: "he wasn't rising above that low expectation. And I knew he was capable of it. … I don't think he wanted to be the one to shine." Omari admits to this period of momentary surrender to the strong temptation to "be this stereotype that totally wasn't me."Omari articulates many of his self-concept belief through affective responses to questionnaire and interview prompts. He discusses his enjoyment of mathematics and speaks confidently in regards to his competence and ability. He comments about his interest and engagement in mathematics, along with his motivation to achieve in mathematics. He comments about his efforts to achieve in light of his self-perceived ability and also reveals what causes him anxiety in his pursuit of mathematics competence and excellence.

Omari generally shares very positive feelings about mathematics. On the Self-Description Questionnaire II (SDQ-II), Omari's responses are remarkably consistent from 2011 to 2012 (Appendix O4). On a 6-point Likert scale ranging from 1: "Not like me at all" to 6: "Very much like me," Omari responds with a 6 on the item naming mathematics as "one of my best subjects," on the item reporting that "I have always done well in mathematics," and on the item claiming "I get good marks [grades] in mathematics." Omari also ranks highly the degree to which he "look[s] forward to mathematics classes." The only item, out of ten specifically mathematics self-concept prompts, that changed at all reflected an increase in his enjoyment of studying mathematics (from 3 to 5).

Omari readily shares that many of his experiences in mathematics have been enjoyable ones. The extent to which he enjoys mathematics is likely closely related to the happiness he expresses he feels from the bulk of his experiences with it. He writes in his mathematics autobiography that he was "so happy" in kindergarten when he took it upon himself to take a timed test for second graders, and upon being pleased (and surprised) by his competence, "the teacher called me out in front of the class and told everyone what I had done." He writes again about being "so happy" in the seventh grade after his teacher explained "how I was going to teach myself math." In a third instance, Omari recollects having identical emotions of happiness when, in the third or fourth grade, he began to comprehend factorization of numbers into primes using factor trees. Omari's enjoyment of mathematics is linked, then, to the happiness he experiences in pursuing and achieving mathematics competence and excellence. Omari affirms, "I love being good at math." His father maintains, "Omari has always demonstrated that he loves math. He really enjoys math. And Omari … seems to be a natural math student, if you will. It comes to him very easy, it appears."

Omari speaks about his mathematics competence with considerable confidence. As a matter of fact, he describes a best friend and himself as "math geniuses." In an earlier interview, he concedes, "I'm not the best math student in my class," but acknowledges that the fact that some of his classmates come to him for help in mathematics "kinda boosts my self-confidence." Omari's mathematics confidence and efficacy enable him to perform as independently as he wants to be in his mathematics class. Although his class provides opportunities for collaborative exchanges, Omari and other capable, responsible students were given the option to learn more independently:

> So, we were able to teach ourselves the math. And then we'd do the work and the lesson and everything. And then, if we thought we were good—if we thought we had it down pat—then we'd check the paper off, and then have her [the teacher] look over our work. And then, she'd sign it. And so, we could move on to the next lesson. So, basically I was teaching my own self math for the second half of the year.

From Omari's description, his own mathematical ability and his certainty of its strength helps him to progress. His mother notes, "It's just a confidence that he has that I didn't have as a student. … And I think he does have a confidence that's pretty amazing for somebody [who is] 13 [presently 14]. Additionally, she observes that Omari is "fearless about learning."Despite his mathematics proficiency, Omari admits occasional feelings of anxiety. The anxiety he experiences, however, is not from the difficulty of the content. Instead, it is associated with pressures he feels that are imposed upon him by others. For example, Omari is excited about the opportunities he has to teach himself because "it put a lot of responsibility on me that I liked because then I wasn't pressured to have like the perfect work to show her … . I can know that I'm just trying to impress myself." Also, Omari is not impervious to the pressures associated with different types of testing and the stakes attached to them:

> So, really, even though I'm being given the test, I'm not pressured until other people pressure me. Now, if they give me the test and they're saying that the test isn't pressured, then other people don't pressure me. So, I'm not pressured by them. And so, I'll just be able to go with the flow.

Omari implies that he is more susceptible to the anxiety, when "other people" acknowledge and, in some ways, convince him that there is "pressure" associated with a particular mathematics performance, as is often the case with standardized testing mandates.Typically, Omari relates considerably more positive affective relationships with mathematics. Much of his mathematics self-concept beliefs are expressed through motivational aspects, such as his interest and engagement in the domain. Omari affirms, "I have always been intrigued in math because of the teaching I got when I was young." He connects his interest in mathematics to his early pedagogical exposure. He is most likely referring to his experiences in Montessori settings, which he strongly advocates. When asked if he found his teacher withholding final answers in the *Math Seminar* difficult, Omari counters:

> I believe that it's more intriguing, more than frustrating. … It keeps everyone interested. … Some people don't pay attention sometimes and everything. But when you get that answer, if it's a[n] answer that nobody has done yet, everyone listens up. And everyone looks at the process [by which] they did it.

Omari embraces as challenge what many of his contemporaries find frustrating—the personal pursuit of mathematical knowledge through inquiry and engagement.Omari's interest and motivation in mathematics is also made evident by the attention and focus he devotes to it. Omari explains that at his current school, he and other students have a window of almost three hours to prioritize as time to study and work. Perhaps because of his exceptional focus on his studies during this period, Omari is occasionally berated by some of his classmates:

> I can definitely tell these days people sometimes say I am the 'party crasher.' But I honestly don't care. Because … they give you three hours in the morning to do what you need to do, which should give you enough time to do about half the week's work that they are giving you.

Omari makes the importance of his completing his assignments and achieving in mathematics clear. He describes his routine at home in the following manner: "I come home and I do my homework—especially on soccer days and Boy Scout days. I sit down, do my homework, and after that, I do what I need to do. … But my work always comes first." Although "math comes easy" for him, Omari finds that sometimes he has to devote additional time to his mathematics studies: "I have never done math on the weekend, except this year. And it really helps me think." Not only does he demonstrate interest in mathematics, Omari also exemplifies initiative and motivation to achieve, persist, and excel.Omari demonstrates his initiative and motivation to achieve through his goals, determination, and focus. He aspires to be his class valedictorian. This a priority for Omari although "other people see it as a priority to make someone laugh or to make it look like they're not smart, even though they are smarter than they are. I wouldn't see that though." Omari's words suggest that, at this point, he is on the other side of being embarrassed by, or apologetic for, his ability.

Omari also displays his initiative and motivation through his diligence and focus in [and on] mathematics. He maintains, "I try hard at everything." Omari believes that "being hard working" is a good quality for students of mathematics to possess. He adds that they should "be very adamant about getting things done, because math can take a long time sometimes." So, Omari recognizes qualities that he believes are necessary for mathematics proficiency and excellence and strives to pursue them.

Omari reveals his ability to focus on mathematics as he discusses his intense concentration on its concepts and applications to problems. He talks about standing in front of the board to work on a mathematics problem and going through mental mathematical processes thoroughly before coming to write anything down: “Sometimes I’ll get up on the board and I have to just sit there and look at my problem and I’ll work through it. … So, I did that before I even start writing anything on the board.” However, Omari speaks of this experience of being “in the zone” slightly different from mathematics students using trial-and-error and standard deliberation. Instead, he suggests a connection to mathematics through which he is inspired—almost mystically:

> Sometimes when you’re in that zone, you just flow and you just write. And sometimes you don’t even notice it. And sometimes be like, “Oh, I finished the problem already!” And then my mom’s like, “But you were sitting there for 15 minutes.” It’s like, “Oh,” ‘cause you don’t realize what you’re doing.

Omari almost becomes enthralled by an active pursuit of mathematical discovery, like a portentous Delphic oracle entranced as she prepares to deliver her prophetic message from the gods.

Constructing Competence

Omari appears to construct his mathematics competence and self-concept beliefs in multiple ways. He draws on the accessibility of his teachers to benefit from the fruit of their pedagogical strengths. Omar largely trusts their assessments of competence and sometimes enjoys personal attention from his teachers as an endorsement of his competence. Support from his parents also shapes Omari’s beliefs. In their efforts to expose Omari to environments that foster his intellectual enrichment, they help position him in settings—classroom and otherwise—where expectations, at least in most recent cases, encourage particular outcomes of success. Part of the reason for such relative success is through interactions within

Omari's peer network. As they share similar academic goals, Omari and his peers collaborate, motivate each other, and hold each other accountable for their scholastic progress. And his development as an adolescent male of color thrusts upon Omari the choices of how he prefers to be recognized and how he recognizes himself. Both of these preferences, however, are subject to the influence of expectations associated with racial identity and identification.

Teacher Interactions. In his discussions about his interactions with his mathematics teachers, Omari generally speaks fondly of a certain accessibility and comfort he feels with them, particularly in the Montessori setting he has found to be supportive. He remembers Ms. Flagg as "one of my favorite teachers, before this year, which is still one of my favorite teachers." While he was in an elementary school after hours academic enrichment program with Duke University, Ms. Star was one in the program who explained it [mathematical content] well for a younger person to get." In other words, she facilitated his understanding of mathematical concepts at an early age. Omar highlights the appropriateness of pedagogy and delivery as being instrumental in his comprehension:

> So, I think, … if Duke [University's program] had taught some people when they were younger, they would've gotten it. But when we're older I think that … it should be taught a different way. But the way they taught it at the age that we were I [think] this was perfect for us. I got it so easily, so well and Ms. Stars was so helpful with it.

Omari also speaks with reverence in regards to his more recent teachers.Although he praises a kind of casual informality of decorum ("At the Montessori school, you can call the teachers by their first name"), Omari respects how familiar his teachers are with his and his classmates' abilities. He also respects his teachers' intolerance of mediocrity in relation to their perceptions of students' competence.

Omari appreciates the precision in his teachers' assessment of ability:

> They don't give us too much of a workload, but they don't give us too less. … And they know what is too much for the students. They know what the students need. And they know what is too much for them.

Omari enjoys the personal attention that one of his teachers gives to evaluating his assignments. He comments that this teacher "will actually come and check over my work more that [he does] other people. Omari maintains, "He will check it as if I was at a different level—a higher level—because he knows that will help me for my benefit only. Because I have started working harder on the things that I do." So, unlike some of his previous experiences in elementary and middle (public school) schools, Omari appreciates his teacher's vote of confidence in his mathematical ability as he undergoes being challenged to complete assignments at a *more competent* level.Similarly, Omari shares that another of his teachers, Lynda, "knows our aptitude and what we can do," and is disappointed when she believes her students underperform. Although he admits that he finds Lynda "kind of intimidating," her command as an instructor in some ways inspires Omari to defer to her authority. Omari reports that he "do[es] math because I want to show her that I can do it, and I wanna show myself that I can do it." For Omari, it seems that his competence must be sanctioned by both his teacher and himself.

Parental Interactions. In addition to supportive interactions he finds at school, Omari also finds a great deal of support in his interactions at home with his parents. He states simply and proudly, “My dad and mom help me a lot.” The assistance that Omari’s parents provide comes in many different forms. For example, sometimes when Omar needs to “stay up until whenever” to complete an assignment, his “mom and dad stay up” with him. Omari’s mother, Mrs. Knight, views their parental role as concerned, “but really not that involved” in the daily details as they were in his early youth:

> Everyday I make sure: “You got homework? What kind of project are you doing? Are you on target to be finished? … Are you gonna be ready for your weekly assessment?” That’s about it. … He’ll ask us if he needs help, or he if needs other resources.

Omari notes that his mother and father engage in these and other forms of “regular parenting,” such as “mak[ing]” him study for tests. Omari is learning to balance accepting and demonstrating more responsibility in pursuing his own education with his accountability to his parents (and himself).Omari’s parents work as a team to provide him with environments where his academic and mathematical proficiency can flourish. They assume different roles in achieving this goal. Omari’s father, Mr. Knight, explains, “I’m the doer. My wife is the one who really is the education guru is our house. I am the support staff.” Mrs. Knight describes herself as “the facilitator and coordinator. I’m there to find the programs, the academic environment that I think they’re best suited for. And then, really, I kind of get out of the way.” Mrs. Knight views her role as one of finding and interrogating, and pursuing environments that will enrich Omari’s academic explorations: “I’ve got to create those opportunities. … I’ve got to research the camps, or I've got to find a school that I want [Omari and his brother] to go to. It's paramount. It's not gonna happen without [our] involvement."

Although the Knights are very involved with helping Omari grow in his mathematical competence, in speaking about his parents' proficiency, Omari notes, "they are not the most mathematically inclined." Omari's father, a former chef and hospital food services administrator, concedes that Omari "definitely knows more math than I have ever taken." Omari's mother, a former clinical dietician, is a teaching assistant in Omari's school. She is forthcoming about her uneasiness with mathematics as she grew into adulthood. Despite whatever perceived inadequacies or mathematics misgivings the Knights profess and/or demonstrate, they remain united in their dedication to Omari's mathematical pursuits.

Omari speaks proudly about his parents' dedication to him and his education. He also seems to admire their own educational ambitions for themselves in spite of their reservations about their own mathematical abilities and histories. Omari's witnessing his parents' engagement and occasional struggles with mathematics gives him an opportunity to assist and support his parents in a reciprocal fashion to the ways his parents assist and support him. Omari's reciprocal assistance for his parents is reflected in the statement, "If I need help, they can give it to me. And sometimes if they need help, I give it to them. For example, Omari shares:

> My mom and I really help each other out, now since she is trying to get a degree in Montessori teaching. We really help each other

> out. And my mom teaches me a whole bunch of things she learns and materials that'll help me. And then my mom will ask me for help sometimes and things.

Despite differences in their relative abilities, Omari's parents impress upon him the importance of mathematics, mathematics motivation, and mathematics competence. Mr. Knight, whom Omari identifies as someone who "isn't really into math like I am," decided to take classes as a local community college "because he wanted to be mathematically inclined." Mr. Knight explains:Math was difficult for me, and I could do a lot of basic math; I could add in my head, I could subtract in my head and I could do all those things that a lot of kids can't do today without their calculators. But when it gets into algebra—and these equations and this over that, x equals this and that—it's just not for me. Now, … I tell my kids how important it is and that they need to learn it.

Mr. Knight maintains that "as parents [we] do have a lot of influence on the child and how they characterize their ability." He argues, "If we're positive and enthusiastic and we try to use many examples as to why this mathematics is going to help them in the future, if they are not already motivated, we have a big opportunity to help motivate them or tear them down."Omari appreciates the support that his mother and father allow him. He understands that his parents "would do anything they can to help me in any way possible—on the Internet or their experience, or … anything else." Omari cites incidents of his parents staying up with him "until three o'clock in the morning sometimes working out math problems." For Omari, his parents' attempts to instill in him a motivation to persist and achieve in mathematics do not go unnoticed. Instead, he stresses how essential his parents' role is as he establishes his competence in mathematics: "They play a huge role. I believe they are right next to the teacher in the role of math."

Peer Interactions. Omari affirms, "My friends are [read: play] one of the most important roles in my math career, besides my parents and my teachers." Along with interactions with his teachers, Omari's interactions with his peers are an element of a school community to which he is comfortably acculturated. It is a community with which he shares similar values about academic and mathematics competence and achievement. Through interacting with his classmates, Omari and his peers are able to motivate each other to learn, achieve, and persist. Although he is able to find exemplars of mathematics excellence within his peer network, Omari is also, for others, an example of mathematics proficiency.

In conversations about his school experiences, Omari often talks about a "community." He describes his "close-knitted" school community as "a whole different type of people." Omari further describes, "They know the expectations. And if you don't meet them, then you are cut." In other words, on the whole underperformance is neither expected, nor tolerated. Omari offers, "I believe it's a good thing to have a community that can really work with the work that they give us." He feels that the community provides an environment which is conducive to achievement.

Among the things that distinguish his current school environment from others he has attended are its acceptance of academic engagement as a standard expectation, and its intolerance of insufficient efforts to pursue it. The community Omari embraces values "of course athleticism and … the regular sociality [sic] stuff that gets you high marks in … our school." But he makes the distinctions that, tantamount to these concerns, are "also your ability to learn stuff and how quick[ly] you learn it. And how smart you are also gets you higher in the social levels … in this school." Omari's statements emphasize that there is a premium placed on academic competence, along with social competence at circles in which Omari participates at his school.

Omari demonstrates the significance of these social dynamics in his social knowledge structure (SKS) graphics. In his first SKS (Appendix J7), Omari chooses eleven words/phrases to describe himself. Among these choices are "social," and "groupy." These expressions explicitly convey his inclination toward the social. Omari also includes interpersonal descriptors, such as "caring," "talkative," and "fun." He notes roles as a "brother" and "athlete," both of which connect him to another individual or team. Omari indicates that he is a "rule follower." This implies that he is vulnerable to prescribed social order. It is interesting to note that despite his school community's emphasis on scholarship, among his self-descriptions, none is explicitly academic in nature. It is possible, though, to assign his description as a "reader" an academic dimension.

In Omari's second SKS (Appendix J8), he retains a number of his self-descriptions—with slight derivatives in some cases—such as "socia**ble**," "athlet**ic**," "fun**ny,**" and "brother." He adds relational descriptions as "friend," "teammate," and "son." Omari also includes, acknowledges, and identifies as both "student," and "teacher," both more explicit associations with his academic world than in his first representation. Adjectives such as "hard-working" and "creative" can be used to describe qualities that could facilitate academic and mathematics competence.

Omari contrasts his public and Montessori school and mathematics experiences and their connections to his life and relationships:

> At public school, our work didn't really get into our social life. It didn't impact our friends. … We didn't get put into any group projects really. And if we were, it was only in the classroom and it didn't really bring you any closer to the people you were working with. It was just because you were assigned to this person, and all you cared about was getting the project done. … In the Montessori environment, you can definitely see the impact that our work has on us.

It appears that in this Montessori setting, the social component of learning, which Omari treasures, is strongly endorsed. Although his affinity for mathematics allows him to work fairly independently, Omari seems to enjoy opportunities to interact with his peers in classroom settings. He especially likes to assist in his classmates' understanding of mathematics. For example, Omari states, "I'll get them on the right track. And then they'll be like 'I've got it from here, 'cause they know that I've taught them enough." Furthermore, Omari maintains:I've made it clear to them, so they can do it on their own now. So, they know that they can do it by theirselves.

So, it gives me kinda that teacher feeling where you know, "Oh, I've just taught somebody something. I feel good about myself."

In other words, Omari positions himself as a *competent* student—in some cases, more competent than the peers he assists. Ultimately, however, Omari ascribes competence both to himself as a peer teacher, and to his classmates who become able to do to do it themselves. For Omari, the reciprocal capacities to teach and be taught mathematics indicate varying degrees of competence.Omari and his peers motivate each other in their study of mathematics. He explains, "We teach each other and … we push each other. We teach each other and we learn together." Omari recognizes the strength of collaborative efforts in motivating his and others' mathematics engagement and performance:

> So, what we do is we kinda monitor each other. And if someone's behind, we either push them, or the teacher pushes us, or my parents push me, or something like that—but mainly the people from your group. If one person is behind, the whole group can get behind also.

Omari manages accountability to his group and to himself. He finds among his peers a kind of friendly competition that inspires sometimes greater effort to achieve goals that appear to be consist within the peer network:I teach myself and two other kids in my class teach theirselves also. So, we're always asking, "Oh, what chapter are you on, so I can catch up with you or you can catch up with me, so we can be on the same level. Because we all wanna start geometry this year. So, we're trying to finish up the other math book. The other math book is supposed to take two years. But we're trying to finish it in one year.

Omari insists that "the whole classroom kinda does whatever we can to get the whole class at their best." In some ways, then, Omari's progression in mathematics competence is linked to his peers', and vice versa.Omari is often an example because of his level of mathematics competence. He assesses, "By what I have seen, I believe that my friends think of me as a good math student, because I really excel in it. I'm ahead of most people in my class." Despite this recognition, though, Omari finds among his peers a number of exemplars he admires. Omari positions these peers (and himself) along a continuum of mathematics ability. This type of positioning is facilitated by his classroom configuration, which combines seventh and eighth grade students. Among the peers that Omari references is his friend James. James has goals and experiences that are similar to Omari's. He participated with Omari in some of the same enrichment programs and aspires to attend Yale University. Omari mentions another classmate, Nancy, whose scholarly disposition and determination he respects and admires. Like Omari, Nancy derives joy and satisfaction from helping other students understand mathematics. Also, she "has learned a lot of processes," and "really wants to show her work." She shines in *Math Seminar* because "she will defend her process … she'll defend it like her life depends on it." In his statement, Omari highlights the ability to learn mathematical process and the capacity to present and defend mathematical arguments.

In his interviews, Omari talks about one student considerably more than others. This is Dennis. Dennis is "a grade ahead" of Omari and is "really smart in math." Omari's perceptions of Dennis are rather revealing. Dennis is "this guy who you'd think never pays attention in class and always goofs around. But he is really smart." Omari often repeats a refrain of how "smart" Dennis is. However, at the same time, Omari notes that Dennis is "not very street smart in how to act and his behavior." He cites as a shortcoming the fact that Dennis "doesn't want to do extra work. He just wants to do enough. And then once he does enough, he doesn't want to go above and beyond." In Omari's eyes, ability should be coupled with diligent efforts to achieve and extend mathematics competence. Although Dennis is a "skateboarder" and an "athlete," he defies stereotypes of intelligence often associated with these arche*types*. Omari claims that without knowing Dennis, people might assume that he is "the dumb jock that always plays around." Although Dennis hardly initially talked about his work in mathematics, Omari would come to witness more of Dennis's ability through interactions in class. For example, Omari attributes his understanding of parabolas to a presentation Dennis gave about them. As he describes Dennis, Omari states:

> He is so good at teaching things because he has been in Montessori his whole life. … He has been 11 years in Montessori. And it was so easy to him to get these math concepts that take me so long to get out in words. It took him seconds. And he taught it so easily. He taught it as easily as our teacher does.

As suggested previously, Omari values the ability to teach as an index of competence. To some degree, he also values the speed at which a student is able to execute mathematical enterprises. Omari credits Montessori teaching methods and strategies with strengthening Dennis's ability to teach—and, by extension, his competence.Although he lauds Dennis's intellectual acumen, Omari also questions some of Dennis's choices. Despite Dennis being able to "teach … so easily," Omari is troubled by the fact that "he hides it from people." The way that Dennis camouflages his intelligence behind jokes confounds, yet intrigues, Omari:

> I think that's what pushes him. To make those smart jokes, he has to have the facts to back them up. So, of course, he'll have all these facts and he could make jokes about them to his friends and everything. And that's what kinda pushes him to learn more. And he can, of course, keep his comedy level.

The intellectual caliber of jokes becomes, for Omari, an indicator of mathematical understanding and talent. Jokes and riddles for Omar and his peers are not a scarlet letter identifying with shame the members of a nerd community. Instead they become a shibboleth signifying, like a proudly worn medal, the distinction of belonging to those ascribed with mathematical competence. In keeping with the comedic tradition, Omari recalls the following incident:I was on Facebook … [with] my friend. We were talking about [being] over the hill and [being] forty and things. … I put a witty little comment on that. I said, "I don't say forty is over the hill. I say it's past the vertex of the parabola."

Omari only expects those who possess a certain mathematical sophistication to appreciate such wit.*Racial Identity and Identification.* The ways Omari identifies, and feels that he is identified, racially also contributes to his conceptualizations of mathematics competence and mathematics self-concept. Despite expressing views initially consistent with a colorblind ideology, Omari begins to view some of his experiences as possibly racialized. The presence and salience of racial stereotypes, though disparaging, provides impetus for Omari to combat by his example negative notions about *who* is able to excel in mathematics. Despite wrestling with these images and perceptions—and at times considering their validity—Omari resolves to maintain high expectations for himself and to inspire others to have them for his mathematical competence.

Omari asserts, "I don't feel [that] race matters." Although his status as a racial minority is evident, Omari insists:

> There really is no separation for me and any other student because of my race, or because of anything else really. Everything is so personal at the school that you really don't have any separation, or you don't really have anything to separate you from [others]. Everyone is on their own level of education and ... your race is just another little tiny difference that nobody cares about—which is a good thing because it shouldn't matter.

Omari may inherit parts of his beliefs from his father who, upon being asked how he identified *racially*, responds with philosophically moral and religious affirmations:How do I identify racially? Just in a general public? I believe that we're all the same. I believe that I am no better than any human being on the face of this earth. I believe that all people should be treated equally and fairly. I don't care whether it's race or religion; I totally believe in Jesus Christ and believe he died for me and for my family and everybody else on this earth that wants to believe in him. But if you're Hindu or Muslim or Buddhist or atheist, I'm still going to love you as long as you're not hurting me and my family. Now, so that's kind of how I identify racially. I threw religion in there too. But I just believe that people should get along and treat each other with dignity and respect.

Upon clarifying my request, Mr. Knight, distinguishes, “I identify as a White male. I don’t know what that gets me in life, but I’m a White male.” Omari’s father surrenders to the reality of racialized experiences: “It shouldn’t be a race thing, ever. It just shouldn’t be but I know it, I know people do that.” Although both father and son prefer an egalitarian ideal of racial irrelevance, they both—when prompted to—begin to recollect experiences that force them to confront these ideals more soberly.Part of the Knight family racial reality is that it’s biracial composition. Although Omari is the biological son of a Black father and White mother, he was adopted in his infancy by Mr. and Mrs. Knight, a White father and Black mother. Years later, the Knight family adopted Omari’s younger brother, Jeff, another biracial male. So, Omari’s racial background is a composite of both African American and Caucasian American lineage.

Because he sees, at least in his school setting, race as largely irrelevant, Omari sometimes struggles when he feels “forced” to select a predetermined racial category. How he chooses to identify himself—at least for demographic assignment—is not always consistent: “Whenever I get tests like that, I have to check ‘other’ or ‘biracial.’” Omari explains, “If you put down ‘biracial,’ it works for me, of course, because I am Black and White.” In another instance, however, Omari offers, “I just mark ‘African American,’ because that makes a lot of things easier.” It appears that Omari is making a concession for those around him “because when people look at me, they usually think I’m African American anyway.” Yet, he also grants that he views himself “more as an African American,” because "my skin tone is darker." He also states that he "can see that mix of things definitely in me. I can see the mix in some of the qualities I have." It is uncertain which qualities Omari distinguishes as African American and which, as Caucasian American though. Omari deems his biracial background as the reason that he has been a target of some joking from his peers: "They were making jokes about this. … So, I was nicknamed an 'Oreo,' because I was Black and White." Although Omari claims that this "really didn't have any effect on me," it is hard to imagine being unscathed by "jokes" about aspects so potentially essential to an individual's selfhood—however innocuous they may, or may not, be disguised to be.

Whether he identifies as biracial or African American, Omari is keenly aware of his minority status at his school and in his classroom. He specifies that "in fourth, fifth, sixth, seventh, and eighth grade, [there are] no African American females." He points out, "I don't have many African Americans in my class. Actually, I don't have any. It's just me, and it's another guy. Omari indicates that this other student "is not fully Black either. He's mixed." What Omari does not say explicity is telling. He does not state that there are not any *other* African Americans. Yet, in his next sentence Omari suggests that he identifies as African American ("It's just me…"), then finally distinguishes himself as bi- or multiracial ("not fully Black either"). His racial identity continues to be in formation.

Although he may be uncomfortable with its acknowledgement, Omari is growing more cognizant of the impact of race and racial stereotypes in his life and the lives of those around him. He struggles with this admission and seems determined to remain optimistic: "Race is definitely used to predetermine someone in school … I haven't had that experience yet, but I hope not to have one because of how America is going. I hope we get past race and how it affects us." Omari's father expresses similar optimism. Yet, his optimism is tempered with uncertainty. When asked whether he believed being African American affected Omari's schooling experience(s), Mr. Knight responds:

> I would want to say no, it hasn't. But I can't be fully positive. I can't be fully positive. I think that it's very likely that one-on-one or in settings where we [parents] weren't around, that things could've been said or insinuated, or that he could've gotten less treatment than others or less guidance than others. So, I can't without a doubt say that he's not been affected by his race.

In hoping for the best amidst the likelihood of inequitable treatment, Omari's challenged optimism mirrors his father's.Despite his and his father's optimism, Omari and his family are well aware of the pejorative images and stereotypes of African American in general and specifically in academics. Omari has not escaped the negative imagery and perceptions of African Americans. Microaggressions and other evidence of the salience of stereotypes become evident from his interactions with others. Omari remembers the comments of some of his peers: "When I hang out with some Caucasian people, they're all like, 'Oh, I'm surprised you weren't sagging the first day you came to school.'" Omari is repulsed by this trend of letting your pants "sag" well below your waist, often to the point where portions of undergarments are visibly exposed. He also points out that many individuals, other than African Americans, have adopted this style of dressing. Not only does Omari acknowledge the existence of such negative images of African Americans, but he also is mindful of how, in his behavior, he can counteract such stereotypes. For example, Omari choses not to admire nor idolize “these stereotypes of Black people dancing at the clubs and getting themselves into trouble with guns and violence.” Instead, he looks to examples of success “like Tyler Perry, who owns Tyler Perry Productions. And he wasn’t a thug. He was a successful businessman who knew what to do and when to do it.”

Despite his contempt for such disparaging images of African Americans and his rejection of their validity, he sometimes finds himself bound to them—either by others who associate him, as a person of color, with the stereotype or by his own choice to engage these beliefs. Omari relates that he likes to dance. Yet, he was cautioned by his mother against dancing—or at least being seen dancing—in a parking lot. She was concerned about the perceptions of those who would witness Omari dancing. Omari talks about being “aggravated” by the thought that his “freedom of expression” would be associated with icons of rap culture, such as Soulja Boy and L’il Wayne, and that it might be assumed “I am going to get tattoos on my teeth … and go to jail.” According to Omari, Mrs. Knight worried about Omari’s actions being interpreted as support for a stereotype “that all Black people wanted to dance in the parking lot.” Omari maintained that these people would view a young teenager dancing as “setting himself up for failure, as he gets on to his life later … and get arrested.” Omari concludes:

> It wasn’t because my mom was trying to stop me from dancing because she believed these things. It was because she knew *other people* were looking at me because they believed these things,

> and she didn't want me to get hurt or anything by them looking at me.

Omari also talks about being unsettled by other presumptions of criminality.He recounts a classroom incident in which he and a friend heard police sirens: "My friend … said, 'Oh, you better run.' And I asked him why. And he said, 'Because you're Black.' … And I was very perturbed by him saying this." What is more unsettling about this incident is that the student who urged Omari to run is a child of color. There are at least two disturbing realities. If this student was joking, his joke hints at first-hand knowledge—evoked in this instance at school—of the association of the color of him and his friend with criminal behavior, instead of the academic exploits. And in the unlikely case that Omari's friend was serious, then this reality is all the more offensive and tragic in its implications

Omari also admits to participating in such behaviors to some degree. He recalls the following exchange with likely the same classmate:

> We're the only two Black people in the class – we joke around with it. We'll come up to each other, "Hey, brother," something like that. We joke around with it because that's what people expect of us. But when they see we're joking around they know that we're not the stereotype of that.

Omari states that his peers will look at other people "across the street from the school" who seem more "stereotypical:" "So they'll look at them, and then they look at us and wonder how the difference comes." The subtle distinction identifying the "stereotypical" African American "across the street" from school is striking. These individuals are removed from academic exchanges in locale and in association. Omari implies that joking with his friend in this manner can perhaps shorten the divide separating what some consider incompatible images. Omari presents to his classmates familiar, but unflattering, images of Africans situated in a context of academic competence and success.In other beliefs he articulates, Omari provides evidence of the influence of some of the very attitudes he is determined to confront. He declares, "I'm not going to do anything … that the *stereotypical* Black person does, which really astonishes a lot of people. The same thing with my best friend. People are blown away that we aren't stereotypes." Yet, despite his conviction to counter by example negative stereotypes about African Americans, it seems he begins to acknowledge some of these views as legitimate. He posits, "Some of the stereotypes that we have are definitely true." Omari refers to perceptions regarding academic motivation and diligence. He "do[es] not see them really taking math seriously." Omari draws more on his sixth grade public school experience where he was annoyed to be "the only one" who gave math serious attention. Omari doubts that these students face any accountability at home from their parents and he disparages the minimal effort he believes many African Americans devote to the study of mathematics and education.

Closely related to the idea of stereotypes is the notion of associated expectations. When asked whether he felt that being African American affected his schooling/mathematical experiences, Omari responded that he believed "they did in *good* ways." Omari comments on the diminished expectations he has already faced:

> I believe a lot of people—and especially a lot of my teachers—had lower expectations for me. I don't know if it was because I'm

> Black or if because most students are like that way nowadays. But a lot of people are surprised when I really do good and excel in math. And they're like, "Oh, you're good at math!" And so, they underestimate what I can do. But after a week or two or so of seeing what I can do, then they'll know the expectations.

As stated earlier, Omari is uncomfortable in attributing low expectations of ability and motivation from others to race. He begins to recall instances though that make him question his reservations. For instance, Omari recollects one of his teachers being "so surprised" that he and another student (of color) quickly finished a problem: "[She] was blown away. … And then she was surprised when a Caucasian boy got up there, and he's not really good at math. And he really didn't do as well." Whereas before Omari divorced the likelihood of race from some of the situations he experienced, he infuses this recollection with resignation that "this is what the world has come to." Omari also notes, "That's when I really started to notice how [unappreciated] Black people are. And my mom had been trying to explain that to me, but I didn't believe her until I really started seeing how people look at African Americans."

***Face*-ing the Nation**

As Omari begins his eighth grade year at the same Montessori school, he will continue to extend his ideas about mathematics competence and self-concept beliefs. His conversations reveal a peculiar concentration on the face as a window of competence perceptions. Omari talks about a face of trying, and an associated face of focus when an individual enters "into the zone." He also mentions faces of disappointment and surprise from teachers when students fall short or exceed expectations, usually based on their presumptions. Unfortunately, these presumptions are often connected to well-established stereotypes about ability and motivation.

Omari's mother is concerned about perceptions of Omari's ability. Despite occasions of diminished expectations, she insists, "I need people to expect him to know." Whatever expectations Omar encounters, he, in turn, expects to be able to gauge these by inspecting the faces of those who assess his competence. Omari already acknowledges how national standardized test scores are disaggregated by racial categories. That is, he is aware of the existence of an association of racial demographics with mathematics achievement. Although he is familiar with this association, it is unlikely that he fully appreciates the scrutiny under which his mathematics and academic performances will come or the generalizations that may be attributed to him and students who look like him.

As the United States commemorated the 50th anniversary of the March on Washington, D.C., attention has been focused on historic and present realities of race relations. But what does Omari detect in the face of the nation? What does he come to believe about himself and other people based on the countenance of a country? What messages will he reject? Which ones will he accept and embrace? As he continues to build his sense of his mathematical self, it is unrealistic to suspect that Omari will escape America's gaze. But just as Omari's self-perceptions and motivation are affected by America's expressions towards him, perhaps

America’s perspectives regarding the mathematical competence of African American youths of color, too, can be transformed by Omari’s expressions.

Chapter Six:
AMINAH: Marching to the Beat of a Different Drummer

The feeling I get

Is slightly queasy

It makes my stomach extremely uneasy

Whenever I get a new problem,

I imagine myself fleeing

To a place without

Square roots and dividing

I feel confused

A little bemused

Nothing makes sense

When they ask me to find "x"

Why's there a little letter

All alone

In a forest of bizarre numbers

I would be content

If I never had to see another page

Filled with wacky numbers and signs

Designed to confuse the normal mind

And seem to just be taking up pieces of my time

~Aminah

Aminah indicates that she likes “words and letters,” and that “math is the opposite of everything that I love.” It is not surprising, then, that she is the only student enrolled in this study who had chosen not to participate in the mathematics class of the 2011 Channel the Challenge summer enrichment program.

Aminah articulates her experiences, remembrances, and feelings with adolescent fervor. Yet, her fervor is mediated by the type of poise and restraint that suggests a more seasoned disposition than one might expect from a high school freshman. So, is it surprising that despite being only fourteen years old, Aminah describes herself as “mature.” Her self-awareness, I would discover, does not fully protect her from assaults on her developing self-concept(s).

Aminah’s presentation of herself is carefully crafted. Her glasses are functional with just enough style to suggest both an awareness of trends and a creativity to modify them. Her hair, like her mother’s, was twisted into dreadlocks. She would occasionally highlight some of her locks into corkscrew twists with blonde streaks. On one Sunday afternoon, she wore a gray hoodie, a necklace, and black sweats. Her fingers on each hand alternated with purple, then blue, fingernail polish. In a room on the fifth floor of the office building where her mother worked, Aminah shared with me her feelings of mathematical competence and her mathematics self-concept beliefs.

Mathematical Competence Beliefs

Aminah's mathematical competence beliefs are rooted in her conceptualizations of what mathematics is and what comprises mathematical activity. She describes mathematics as "using numbers to figure out an equation or a problem." Mathematics, for her, appears to be a procedural enterprise that is useful in its instrumentality. She posits:

> When you relate math to stuff you do every day, it makes it easier to understand it. 'Cause like when you just do it in school, you don't really understand why you have to know it. But when you relate it to like shopping and … adding up your total or whatever, it makes it easier to understand why you do it.

Within the routines of her daily life, Aminah recognizes experiences where she utilizes math, or at least she contemplates incidents with connections to mathematics (Appendix L1). In addition to "counting change," and "calculating the cost of a book with discount," she lists other daily life exercises that involve "figuring." A few of these are associated with Aminah's engagement in marching band activities (e.g., "counting the beats in a measure," "figuring out how to march double time, and "counting notes for a clarinet solo). Most of the mathematical concepts that she associates with her activities are often single applications of fundamental operations of addition, subtraction, multiplication, and division. However, Aminah also includes processes of partitioning time and measuring [or measurement]. The activities she lists, the connections she makes, and the precision she implies in these tasks all support Aminah's description of mathematics as a tool to "figure out" problems and equations by "using numbers."Among the components of mathematical competence that Aminah explicitly enumerates are effort, and asking for help, when necessary. Some of the effort that competent students exert is through studying of examples, textbooks, and notes. Aminah insists, "You have to study." She asserts that the reason many students do not do well in mathematics is that "they probably just don't apply themselves as much as they can. 'Cause I think that anybody can be good at anything if they try. Some people might have to try harder than others." Further clarifying what students should attempt Aminah affirms that "if they don't understand, then they need to … not just try to understand, but they need to do more than they are doing. … If you need help, they need to ask." Aminah's comment suggests that such effort is an integral component of mathematical competence.

Aminah's statement also implies that certain motivational aspects are necessary. "Doing more" and seeking out assistance require elements of persistence and initiative. She maintains that being able to relate mathematics "to stuff you do everyday" provides "more reason to … focus more and practice more." In her comments, Aminah links effort, attentiveness, and motivation to understanding.

Although she does not address it specifically, Aminah's statements suggest that she considers understanding and application of concepts as critical components of mathematical competence. She presents understanding not only as an inherent goal of mathematical pursuits but more as a prerequisite for competence. Aminah distinguishes the relationship between understanding and memorization:

> I don't know if you have to memorize notes, you just need to be able to understand them and apply them. … 'Cause problems are going to be different, so just memorizing your notes isn't going to help you understand how to do it for yourself.

In her statement, Aminah does not endorse memorization as an end in itself. Instead, memorization becomes a tool for further analysis and exploration, rather than a proxy for comprehension.Aminah also relates understanding to participation and confidence. She maintains, "I would judge how confident [students] were based on how they participated in class, 'cause if you don't understand [mathematics], then you're probably not going to participate that much." So for Aminah, participation presupposes understanding. It is also a barometer of academic confidence.

Aminah's endorsement of natural ability, and its facilitation of understanding, appears equivocal. At one point Aminah states, "Natural talent might make it easier to be good at math, but… if you practice hard enough it will mean more than if you're just good at it but you don't try, like you just slide by." Although it may be uncertain if she is considering "natural talent" as doing well (grades, achievement?) without much effort, or as understanding concepts, or something else, this statement reveals Aminah's acknowledgement of and belief in its existence. In another instance, though, Aminah asserts about mathematical competence, "I don't think it's … a genetic thing or that your parents pass [it] down to you through genes." However, she believes that it "makes sense" that if your parents understand mathematics well, then it is likely that their children will also.

Aminah beliefs about mathematical competence flow from her conceptualizations of mathematics and mathematical activity. Mathematics is useful "to figure out … a problem." She appreciates it as a procedural enterprise that she enlists to count, calculate, and measure. Through applying concepts, students gain an understanding. This understanding becomes a critical component in Aminah's composition of competence. Also, effort and asking for help are integral components of mathematical competence. Exerting effort and seeking help are examples of some of the motivational aspects of mathematical competence. Although Aminah does not believe that competence is a "genetic" thing, she asserts that parental facility and understanding of mathematics makes their children's competence more likely.

Mathematics Self-Concept Beliefs

Through interviews, questionnaires, and documents Aminah provides information about her achievement. However, it is through writing that Aminah shares the more affective elements of her mathematics self-concept. The original poem that opens this chapter is one of her expressions about mathematics. Aminah also reveals some of her experiences, feelings, and beliefs in the mathematics autobiography she composed.

Aminah's poem contains a number of adjectives (queasy, uneasy, confused, bemused) that describe an almost visceral reaction that Aminah has toward mathematics. Mathematics, for her, is a realm where "nothing makes sense." It is a place filled with nonsensical, "wacky [and bizarre] numbers and signs." Aminah also seems to envision mathematics as part of a nefarious plot "designed to confuse the normal mind." Her contentment lies in "fleeing" the icy hold it has on "pieces of … [her] time."

Through her affinity for "words and letters" and her predilection for "reading and writing"—as revealed in interviews and her mathematics autobiography—Aminah establishes two periods as being significant in her mathematical history. The periods include her fourth and seventh grade years. Although she writes and talks about the seventh grade more fondly, Aminah attributes much of the angst and apprehension she feels about mathematics as having begun in the fourth grade. She points out, "I was never drawn to math. I do think that I got worse at Math and started to feel negative about it [mathematics] during and after 4^{th} grade, before that I don't think I felt anything strongly about Math."

For Aminah, receiving a grade of C in fourth grade mathematics was instrumental in the development of her mathematics self-concept:

> In fourth grade I started to feel that I was not good at Math. I don't remember anyone ever saying that I was not good in Math. I got the only C I have ever gotten in Math that year in fourth grade—in a way I guess that C made me think I wasn't good at Math, because a C is not a good grade.

Her statement is informative in a couple of ways. First, it establishes a prior history of successful achievement in mathematics. She implies that she probably felt good about mathematics before, or at least her performance in it. Second, her comment seems to privilege an attachment of her math self-concept to grades rather than to a relationship of self-concept with comprehension, performance, or other factors.As she reflects on her fourth grade experience, Aminah pinpoints it as the time when she began to feel apprehensive:

> I feel that fourth grade is a critical Math year because you learn about working with multiplication and division and I really struggled that year, so I've been kind of behind in Math ever since then.

It remains uncertain whether her classification of the fourth grade, in general, as a "critical" period is a conclusion she came to through her own and her classmates' matriculation through it and engagement with the curriculum. Or is it more of a characterization she distinguished as a result of enduring an unpleasant grade experience? Whatever the reason for her distinction, Aminah would have a different experience a few years later.Despite what may have been for her an uninspiring fourth grade year, Aminah had a more encouraging seventh grade experience. She reports, "In the middle of my seventh grade year I was switched to an advanced Math class." During her seventh grade year, Aminah was taught by a teacher whom she described as "a really cool Math teacher who was fun." Aminah observes:

> The new section was different. We had more freedom. We didn't just sit in our desks and do problems, or watch her write on the board. It was more interactive, more partner work and games and I really understood what she was teaching.

Interestingly, Aminah attributes much of the difference in her fourth and seventh grade experiences to the teacher:Well in 4^{th} grade, I got kind of behind in math

’cause my teacher wasn’t that great. So, I feel like I’ve kind of been behind ever since. And then in 7th grade I actually started enjoying math more, cause I had a really good teacher and I understood everything and I actually got an A in math that year.

For Aminah, the teacher has an essential role in the connection she makes between her enjoyment of mathematics and her understanding of its concepts. As she considers her preference for certain areas and topics of mathematics, Aminah provides evidence that this connection endures beyond her seventh grade year: “I guess the reason why I like algebra more is I’m just better at it than fractions and decimals. I understand it more, so I enjoy it more.”Some of the affect of enjoyment of her mathematics experiences is related to the social component of her classroom. Among other affective components of academic self-concept, the SDQ-II evaluates the level of enthusiasm with which students anticipate their classes. After recognizing a downward shift (Appendix O1) within roughly a year between responding to this item, Aminah acknowledges:

> I don’t really look forward to math as much as I did last year. I guess one of the reasons I looked forward to it at all last year was cause I had friends in there that I knew so, it made it more enjoyable. I don’t really know anybody in my class this year.

The first administration of the SDQ-II occurred in the summer before Aminah’s eighth grade year. This would have been her final year in a familiar middle school setting. The second administration occurred early in her freshman year at a new high school. Aminah would have to adjust from being at or near the top of a metaphorical social food chain to, perhaps, beginning over again from its base. As she reports, Aminah's familiarity and social comfort contributes to her enjoyment of her mathematics experience.Aminah is forthcoming about her aversion to mathematics. In her mathematics autobiography, she indicates, "There has never been a time when I was drawn to Math or particularly fond of it." However, she capitulates as she concludes her autobiography by stating about her seventh grade experience, "I actually enjoyed taking math that year." Aminah recalls being named as a Math Student of the Month that year for the project that she completed. This was the first math class where she had the opportunity to complete a project, "not just worksheets or problems."

Yet, Aminah takes little consolation in either the attention or the recognition that may accompany such achievement. Instead, she explains, "I was proud of myself for doing well in a subject I don't usually do that good in." When questioned about how she feels about receiving attention and recognition for being an excellent student, Aminah responds, "I don't want to say I don't really care, but I don't really think that much about it. 'Cause I'm not really usually acknowledged for being exceptional." For Aminah, this scenario is unlikely in mathematics and therefore, unreasonable to entertain.

Aminah's mathematics self-concept is mired in thoughts of her perceived mediocrity, especially as it relates to her "smartness." She reveals these thoughts, sometimes ambiguously, in the context of her comments and other self-expressions. For example, she concedes, "I don't think that I am smart in math" in an early interview. A brief while later in our conversation, Aminah clarifies, "Well, I am smart, but not like a prodigy or anything. I have like a pretty normal level of intelligence." In the social knowledge structure she composes, she describes herself as "smart-ish" (Appendix J1). Aminah coins this word to describe the intermediary realm in which she locates her intelligence. She characterizes her grades as "average—not like a C-average. But like not extremely smart." Her struggle with securing her mathematical competence continues to endure.

Constructing Competence

To a great extent, Aminah comes to fashion her conceptualizations of mathematics competence through interactions with her teachers, family, and peers. Much of her conversation focuses on exchanges between her and her teachers. Aminah's interpretations of the expectations of these significant others influence her competence beliefs, and her evaluations of her own competence and the competence of others. Aminah also constructs her competence beliefs through enacting aspects of her personal and racial identity. By adopting particular traits and characteristics—and rejecting others—Aminah establishes an identity as a student whose mathematical competence is challenged. She also establishes her identity through positioning herself and being positioned by other in certain ways relating to mathematics.

Teacher Interactions. Many of the interactions that Aminah describes are between her teachers and herself, or between her teachers and other students. Her descriptions of these interactions provide insight into her expectations of her teachers and what she perceives their expectations of her to be. These expectations of teachers and from them—however explicitly or implicitly communicated—are influential factors in the construction of her mathematics competence and self-concept beliefs.

Aminah attributes to teachers significant responsibility in establishing, maintaining, or restoring a sense of security to students regarding their comprehension of mathematical content ("I got behind in math 'cause my teacher wasn't great." She also acknowledges the teacher's role in determining students' affective responses ("I actually started enjoying math more, 'cause I had a really good teacher and I understood everything"). Aminah also ascribes to teachers a fundamental responsibility to help students understand the topic of study. She describes a "good math teacher" as one who "explain[s] it and they go at your pace so you have time to understand it." These educators also provide "lots of examples" and ways for students to remember concepts and algorithms.

In specifying the roles of a teacher, Aminah explains:

> Obviously their job is to teach—to help the students gain knowledge or, more [specifically] to expand their knowledge of a certain subject. Since everything is really just building off of whatever you learned last year, then just to teach … and answer your questions and just help you understand the world as a place more.

Aminah expects, it seems, that teachers broaden the scope of their commitment to students to include an understanding of the curriculum, perhaps as a representation of content, but also an understanding of their community as a microcosm of the world. In this way, she typifies those students who seek a warm, but demanding authority figures in their educators.Unfortunately, though, Aminah has found neither a warm, nor a particularly demanding environment in her mathematics class. Some of the warmth that African American and other students seek is communicated through attentive, yet rigorous instruction. Yet Aminah describes the following mathematics classroom routine:

> My math teacher doesn't really do anything. My math teacher this year isn't that great … She just really doesn't address things. She will give us a packet; she will give us 30 minutes to do it ourselves even though if she hasn't taught us how to do the stuff. And then she will go over it. And then, she will just sit at her desk and do whatever she does for the last hour of class.

Although the school has lessened the teaching load of this educator, Aminah has found no consolation, as she has remained under her teacher's instruction:Maybe by giving her less classes, the administration was hoping that she would have less to worry about. … From my standpoint, it hasn't really changed or anything. I don't feel like I'm learning anymore in her class than I was before.

Despite what may be administrative attempts to curtail a negative learning and teaching environment, Aminah still feels captive to an unproductive and unmotivating mathematical classroom experience.For Aminah, not only are teachers able to stifle feelings of competence, but they are also able to make them flourish. She posits, "Well, I think that if a teacher does a good job teaching and explaining the subject, then their students will become more confident of their ability." Aminah speaks favorably about her interactions with three teachers. She singles out her seventh grade teacher as the sole math instructor whose instructional methods helped to facilitate Aminah's comprehension. Aminah also holds her language arts teacher in high regard:

> Well, … my language arts teacher, I consider her good ‘cause she genuinely cared whether or not we grasped a concept. Like at one point, everybody was struggling on a sentence type. So, she kept going back and teaching it in new ways to make sure that everybody would understand it. And I had a math teacher in seventh grade who did the same thing. We didn’t understand, and she would give us new activities and explain it in different ways.

The concern these teachers demonstrate to their students by doing whatever it takes (explaining, explaining again, and explaining in different ways) to help students gain understanding, competence, and a sense of competence evinces the type of care that many African American students respond to from their instructors. Aminah notes that her band teacher “expects a lot more out of me,” and that he is “interested in people.” Aminah’s observations of these teachers suggest that they subscribe to African American educational ethos which addresses high academic, and personal expectations and implements pedagogically and culturally appropriate instruction. These teachers attend to person-centered instruction while demonstrating an ethos of care and concern. Although the teachers vary in their content area, they share a dedication to this ethos. This ethos of teacher care and concern, as manifested in sound instruction and high expectations of students, inspires these students to realize that competence is worth striving for (indeed, that it *must* be striven for), and that it is within their grasps.*Family Influences*. Aminah engages in interactions with her family that influence her beliefs about mathematical competence and her own mathematics self-concept. She finds in her family exemplars of mathematical competence and is able to position her own ability and motivation in relation to these exemplars. She mentions that “I have uncles and my grandpa and my aunt who are good at math. So, if I need help on a problem, then I can call them. And they will try to explain it as best as they can.” She explains that her grandfather teaches for a General Educational Development (GED) program. She also admits that because of changing standards and curricular changes, “he does help sometimes, but sometimes he … makes it more confusing.” She endures apprehension at school, and then faces occasional frustration from confusion that she hoped assistance from home would dispel. At these times, her mathematics anxiety may be compounded by good- intentioned help that only led to further confusion. Aminah also states that her brother has strong mathematics ability and sometimes is able to help her. Her brother, though, is two years younger than she is. To be assisted by a younger sibling may at time have an effect of decreasing one’s own self-concept evaluations.

Aminah views herself as mirroring aspects of her mother’s mathematical disposition. She assesses, “My mom isn’t really good at math.” Aminah also contemplates, “I don’t feel she likes math that much. I think it rubbed off on me.” She also posits that “parents play a good part in just confidence in general.” Aminah attributes to parents a significant role in a student’s sense of confidence. She also connects her own uneasiness regarding mathematics to what she perceives to be her mother’s. However, when talking about mathematical competence, she explains:

> Well, I don’t think it's a genetic thing, or that your parents pass [it] down to you through genes. But I think that … if your parents

> understand and it plays a big part in their life, … if they are an account person, then it's going to make sense that you understand it more, than like if your mom is a writer and she doesn't like math.

Aminah's mother, Ms. Jordan, works for a non-profit organization and expresses an inclination, at least historically, toward the arts (for example, drama, music). Although Aminah's father died when she was a toddler, Ms. Jordan reminisces, "He was good at math. He should have been a doctor or an engineer. … He could keep track of numbers like just in his head … in a way that just escapes me." Ms. Jordan assumes some responsibility in Aminah's sense of mathematics self-concept: "Some of it is probably playing tapes from my own—Math was never my favorite subject and I stopped taking math as soon as I could." Ms. Jordan insists, "I do tell the kids that their dad was good in math. And I do sometimes think that if he was here, he could help them with this math. … I want them to know that that's a part of them too." Ms. Jordan enlists memories of Aminah's father's ability in an attempt to buoy Aminah's self-concept beliefs. Apparently, mathematical excellence, along with mathematical challenge, are both parts of Aminah's parental legacies.Aminah's mother plays the dual role of booster of her daughter's self-confidence, and advocate at her school for them to recognize Aminah's potential by placing her in challenging coursework. A representative episode of such advocacy is evident when Aminah was in the seventh grade. Aminah's mother, Ms. Jordan, states about Ms. Jordan that "a lot of her friends were [placed in advanced math], but she wasn't. Admission into the advanced class was based on testing. Although Aminah's family received a letter stating that she was eligible for the program she had tested for during the previous year, Aminah was placed in the regular level course. According to her mother, Aminah was not surprised at the placement: "I am not good at math. So, of course, I am not … [assigned to the gifted section]." Despite a resistant Aminah, her mother pursued getting Aminah in the honors math. Aminah's resistance was based in part on that an entire semester had almost passed and she had grown comfortable with her placement. She also faced, perhaps, the intensification of student expectations in, what was for her, a formidable subject. Despite the characterization that her performance on the placement test might suggests, Aminah views herself as "not good at math." Her being somehow overlooked and allowed to remain in a regular section could for Aminah reinforce her uneasiness about her mathematical competence.

Her mother, Ms. Jordan, expresses the following conviction about deciding to change Aminah's schedule: "It really required me to … advocate with the school that 'No, you said she is qualified, and I want her to have it.'" In describing Aminah's mathematical abilities, Ms. Jordan posits, "I think she has the ability to perform competently in the math where she is. … But it bothers me that she doesn't believe that she can do it. It bothers me." Ms. Jordan is troubled by how threatened Aminah's mathematics efficacy and self-concept appear to be.

In making her decision to move Aminah to the advanced math course, Ms. Jordan received confirmation from Aminah's regular-level teacher who, at the time, suggested, "She should go in the honors math class because she had the ability to perform at that level." So, not only did Ms. Jordan recognize her daughter's ability, she had also received the endorsement of Aminah's present teacher. It is likely that her mother's hope was also to help Aminah embrace a more robust sense of mathematics efficacy and self-concept.

Peer Influences. Through interacting with her peers, Aminah infers messages that foster conceptualizations of mathematical competence. Through these interactions, Aminah engages in positioning self and others along a continuum of competence. She compares herself—and sees herself in comparisons of others—in mathematical areas at school that often employ metrics of achievement. These measures include grades, evaluations of participation, and performances on diagnostic assessments to assess individual competence.

Aminah engages in social comparisons at school, which have led her to question the level of her mathematical capabilities relative to her peers. She maintains that most of her friends are "very good at math. … Most of them are in advanced. So, they're learning … tenth and eleventh grade stuff. And I'm on ninth grade … level." Although she classifies most of her friends as "advanced," she characterizes herself in the following manner: "I think as a math student, I am pretty normal." Her assignment to a ninth grade level mathematics class and her status as a high school freshman may contribute to her sense of normalcy or at least the *appropriateness* of her placement.

How Aminah feels about her grades ("average") may also confirm for her the appropriateness of her placement. In the final analysis she received for the course an "86 or something." This was the lowest of her semester grades. She confides that although she was not surprised by this outcome, she is “okay” with her grade: “I wasn’t unpleased with it. I like getting A’s. So it’s not an A. So, I mean, I wasn’t super excited about it. But better than a C.” Despite her mathematics grade being above average—a fact in which she finds consolation—its ranking as the lowest of her grades may intensify her uneasiness with it as a subject (“I do well in all my other subjects”). Comparing her mathematics performance to her performance in other classes may serve to lessen her estimation and appreciation of her own mathematical ability.

Aminah’s math self-concept and participation may be related in a reciprocal relationship. She links participation to understanding, which is a central component of competence: “If everybody in the class is actively participating, then everybody probably understands it.” Participation reflects understanding. Relating a parent conference communication, Aminah affirms, “All my teachers said that they wished that I had participated more in their classes. … *All* of my teachers said that.” Aminah’s reticence sometimes leads her teachers to position her as non-participatory. Her mother, who has taught elementary students, points out that Aminah “doesn’t like to speak out in class, particularly in a subject that she doesn’t feel confident about. And we know, as teachers, that that makes a difference to how people perceive your intelligence and your ability.” Other people’s perceptions of an individual’s competence may also contribute to both their performance and the self-beliefs.

Although, for Aminah, participation is not integral to competence, it is indicative of understanding, which is essential to competence construction. She correlates her level of participation with her understanding, as she tends to "participate more when I understand it completely." Therefore, when her lack of understanding is made salient, her competence is most threatened. This results in a depressed sense of mathematics self-concept.

Aminah feels conflicted about her level of competence in mathematics. She expresses the following concerns:

> Well, in this math class in particular, I do feel behind—especially regarding my friends who have this new math teacher. They say that they took a test just to judge how much they knew based on the curriculum and what you should know by the … [time you got to] where we are … and most of the people failed it. 'Cause apparently we're not really learning anything in … [my] class. So, I do feel like I'm behind.

Aminah's feelings of being behind are exacerbated by the performance of many of her peers—peers in whose ability she is likely more confident—on a diagnostic assessment. She relies on diagnostics tests, probably along with curriculum and course pacing schedules adopted by her district and school, to confirm her sense of inadequacy. Aminah's sense of inadequacy is somewhat ameliorated by the fact that the diagnostic assessed that "most people" performed relatively poorly:I'm not really that worried about it, since – I mean I am worried, 'cause nobody likes to be behind. But a lot of people are behind. And so, I feel like eventually we'll have to do something about it, if everybody's doing not that great.

She finds consolation in the company of her peers' comparable performance.Aminah speaks about her friends as a community of peer support. Her peers encourage her to do well in mathematics: "They help me. If I don't understand a problem, they usually try to explain it, even though it usually doesn't help. But they try." Aminah also reports that she is accountable to her friends also: "I do have people who check on my grades. Even though they know they can't help me, they want to make sure I'm doing good." At first, Aminah's comments may suggest that she feels beyond the reach of her friends' help. But her statements become more perplexing given that she initially boasts about her friends' mathematical acumen, yet describes these individuals as "close friends that help, even though they are not particularly good at math." In this light, her reservations become attached more to her estimation of her friends' capacity to help than to her sense of the inadequacy of her own competence.

Identification, Identity, and Positioning. The ways that Aminah identifies herself and friends, and her evaluations of their competence, has implications for the manner in which she constructs her notions of mathematical competence, in general, and her mathematics self-concept, in particular. Her distinct preference for language arts, and her affinity for words help Aminah to position mathematics as "the opposite of everything that I love." There could be no more dramatic difference to fuel her aversion to mathematics. Furthermore, she points out that "math is a subject that a lot of people struggle on. It's just hard, harder than other things." As she considers the peers with whom she associates, Aminah highlights that "they like writing and stuff on their free time. ... But I don't know anybody who sits around and does math for fun." She does not envision mathematics as something to be enjoyed, but rather something to be endured.

She compares language arts, which she enjoys most with mathematics, which she enjoys least:

> I think that a lot of people struggle in math and language arts because people who are really good at language arts and stuff, they are more creative. Because you can't just grab language arts and there are lot more things. But math is more exact and there is only one answer to a problem. It's not as open as language. So if you are good at one, you are probably not going to be as great at the other. So really you could fall under one or the other.

Aminah implies here that, for her, mathematics (at least the mathematics to which she has been exposed) is limited by the precision and specificity it offers. It is, in her eyes, perhaps, less inspired and certainly less inspiring. She views it as closed to creativity, "I don't think that creativity has anything to do with math at all. Like I can't think of any instance where it would be helpful to be creative when working with math." And if she recognizes creativity as an essential part of her character and identity, and if she believes that mathematics is divorced from creativity, then she will continue to struggle with her sense of mathematical competence.*Racial Identity and Identification*. Aminah posits, "I don't think that being Black has influenced the quality of my learning experience." Yet, she shares the following observations about her educational history and the salience of race. She explains her racial identity in the following way:

> In the little box, I check off "African-American" every time. But I don't really hang out with anybody. Like technically, that's the

> race I am. But … you know, how nowadays, when people say "Black," they think "ghetto?" Like I don't—and you probably don't consider yourself one of *those* people.

She notes that in her third and fourth grade years, she attended a school "where there's only one White kid, and everybody else was Black." In her first year of high school, though, Aminah indicates, "Most of my friends are Caucasian. And then I have two Black ones and a Hispanic one." The Black friends that Aminah names likely participate with her in the school marching band. She also points out, "Sometimes people will call me an 'Oreo,' which upsets me, but they're not like that. Like sometimes they make fun of me." An "Oreo," Aminah explains, is a person who is "Black on the outside, [but] White on the inside." That is, they have the phenotype of what is typically characterized as Black, yet may have mannerisms, patterns, and traits that are more often interpreted and attributed to White individuals. The characterization of Aminah as an "Oreo" has consequences for her social relationships. It figuratively distinguishes her, to these particular peers, as superficially Black. To them, her "Blackness" runs only skin deep.Aminah comments about her experiences include definitions and distinctions. Yet, they also require others to be made. These definitions and distinctions reveal how Aminah identifies with, negotiates, or rejects, certain aspects of her racial identity. For example, she seems to distinguish that there are different types of African American/Black people. Although she checks off "African American" among the choices she might face in a demographic analysis, she is careful to distinguish herself from Black people who are thought of as "ghetto." Also, Aminah makes a point to indicate that the marching band that she is a part of, and enjoys, "is not ghetto." When asked to clarify what she means by "ghetto," Aminah states, "Well, most of the time, people, like, start talking to me, like in terms of being an Oreo or whatever, when it comes to the music that I listen to, 'cause I don't really listen to rap and stuff." She associates "ghetto" with a characterization of those who listen to rap.

Aminah incorporates this association of being "ghetto" and rap music into her acknowledgement of racial stereotypes of which she is aware. She includes in "listening to rap" among the activities that are stereotypically attributed to Black people [I use the term "Black," not African American because it is the term that Aminah uses most in our conversation]. Although she seems to distance herself from certain types of Black people, her hairstyle of dreadlocks is a strong pronouncement of an African American heritage. Aminah notes that her "hair might make me stand out," and that because popular rap artists, such as L'il Wayne, wear dreadlocks the people may misunderstand that she was doing it to imitate those artists.

Aminah points out that she prefers "alternative" and country music (for example, Rascal Flats, Lana del Rey, Ellie Goulding, Carrie Underwood, Kelly Pickler) over the type of music she often ends up playing in the band:

> I listen to country, which you don't expect. So, like in marching band, we predominantly played rap music or hip-hop, and when people found out I didn't know any of the songs we were playing, they were like, "Oh, my God!"

Aminah maintains that she discovered, years before, that "people expect different things based on the race that you are." Interactions with some bandmates confirm this message.The songs we were playing, they just assumed I would know, since I was Black. … There are things that are expected of you [that] I didn't live up to. … And like particular words, or whatever. Like in band, people would always say, "Turn up!" and I'd never heard anybody say that until marching band.

These exchanges reveal the Aminah was expected to adopt, or to be familiar with, certain African American cultural manifestations, including musical and vernacular expressions. Aminah even states that one of her friends took it upon herself to help acculturate her into these cultural expressions: "One of my friends now in band has made it her mission to change my music taste and make me … 'Blacker' in the stuff that I listen to." Although Aminah does not feel any obligation to embrace and exhibit these cultural expressions, she acquiesces to acknowledge them. And in a prerequisite fashion, she resigns to an expectation to recognize them.

Marching On

Aminah's mathematical competence and self-concept belief are rooted in her conceptualizations of mathematics and mathematical activity. Although she does not enjoy academic exercises in mathematics, Aminah appreciates its usefulness as a procedural enterprise to count, calculate, and measure. Among her more integral components of mathematical competence are effort and asking for help. Understanding also features prominently in Aminah's discussions of mathematical competence components and acknowledges connections to motivation dimensions, such as interest and initiative. Aminah also recognizes the parental mathematics aptitude and interest as potential contributors the students' competence and self-concept beliefs.

Although her aversion to mathematics remains relatively consistent, Aminah's self-concept beliefs, like many things during her transitional phase of adolescence, are shifting and developing. It becomes difficult for Aminah to reconcile her understanding of mathematics as "using numbers to figure out an equation or a problem" and her description of herself as liking "words and letters." For Aminah "math is the opposite of everything that I love." It is divorced from the creativity—and the need for creativity—that she embraces in other, more enjoyable, aspects of her life. With the exception of a couple of favorable experiences with academic mathematics that may have instill confidence in her ability, Aminah's self-evaluations her largely been mired in mediocrity. Her grades are "average," and her intelligence level is "pretty normal." As a consequence, despite a strong academic history, Aminah's weak mathematics self-concept does little to help bolster the development of her future mathematical competence.

However, through her interactions with teachers, family, and peers, Aminah fashions conceptualizations of mathematics competence attempts to establish her mathematics self-concept. She arrives at her beliefs, in part, by coupling her interpretations of expectations and beliefs of these significant others with the ones she has for herself. She also constructs her competence beliefs by engaging aspects of her personal and racial identity. Aminah adopts particular traits and characteristics, while rejecting others, as she establishes an identity of a student with challenged mathematical competence. Aminah is forthcoming about her uneasiness with mathematics. But just as she has learned in her band class, despite with may be an uncomfortable cadence—one that she views more suitable for others—Aminah fights to march forward to advance and persist inher study of mathematics.

Chapter Seven:
TYSON: A Bird of a Feather

When I interviewed Tyson and his fraternal twin brother, Bryan two years ago for the pilot to this study, I met them, along with their younger brother and mother at a local library. As a county resident the mother was able to reserve one of the study rooms for our conversations. I was somewhat apprehensive about having to surrender to these arrangements, although I had failed as a novice researcher to propose any other option that might—in my estimation—be more conducive for my interviewing. How comfortable would each twin be expressing their experiences and their understandings of these not only in my presence, but also in the presence of their mother and younger brother? I had no choice but to proceed. During that first set of interviews, I discovered that, despite comparably strong mathematics achievement from Tyson and Bryan, a marked distinction in their self-concept beliefs existed.

When Mrs. Hammer invited me to their home in the late summer of 2012 to begin a series of additional interview with her sons, I was relieved by the prospects of comfort that I suspected their home might offer. On that early August morning, I traveled some 15 miles from the city to their suburban subdivision. A crepe myrtle shaded their home and the right side of their front yard. A basketball goal bordered the right side of the driveway that approached a two-car garage. Trees and lawns along the street were as carefully attended to as this one. The security sign suggested that although this community appeared inviting and hospitable, it also remained protective and vigilant.

On this morning, Mrs. Hammer welcomed me into their home and offered me a seat in the dining room on my right. On the left was Mrs. Hammer's office area with African sculptures adorning the walls. Across from her office, I would sit at a dinner table that comfortably sat six and waited for either twin. As Tyson made his way downstairs, I could see into the kitchen. His younger brother, Craig, sat on a stool at the island in the kitchen. Mrs. Hammer quizzed Craig, who was in the third grade at the time, on multiplication facts: "Six times nine? What is your answer?" In another subject she instructed him to "read a chapter," then report to her a summary of its contents.

As Tyson came down the stairs and greeted me, he was the student that I remembered. He was thin, and slightly taller than his twin brother, Bryan. He wore glasses, but not today. He was eager to answer questions, but gave each one thoughtful consideration. Tyson had on a tee shirt that covered half of the athletic shorts he wore on this summer weekday morning, which I discovered would be a little more leisure than the rest of his week . This was one of the few days of the Channel the Challenge program that he did not have to report to the university campus to fulfill his responsibility as a Counselor-In-Training (CIT).

Tyson shared with me some of his experiences with mathematics and mathematics classes during what would be his freshman year of high school. He had transitioned from a relatively small independent institution to a considerably larger public school. These changes in his school configuration accompanied concurrent changes in his adolescent development. Changes in his school configuration were also compounded by certain curricular emphases and shifts. How did these changes affect his academic experiences? How did Tyson experience the flux of these simultaneous shifts? How would he articulate these experiences? From my vantage point in his home—with its emphasis on learning and engagement—I was provided additional insight on the perspectives that Tyson was about to offer in sharing his mathematical competence and self-concept beliefs with me that day.

Mathematical Competence Beliefs

Tyson's perspective on mathematics frames his beliefs about mathematical competence. He views mathematics as "a technique in which one can use numbers and digits in abstract sequences to figure out daily problems or needs. For example, I think I used … [a baker] last time as an example … to measure something. Or, if you're an architect or an engineer you will need mathematics to know how you would build something and how it relates to the real world." Tyson perceives mathematics as a "mostly problem solving" enterprise, "not like memorization like all my other subjects." He appreciates mathematics for its concrete applications, yet he seems frustrated by its more abstract formulations: "I don't really see the need to learn … some abstract concepts that won't benefit me. And I don't completely understand that."

Tyson recognizes a number of his daily experiences as mathematical, or at least as involving principles of mathematics. The experiences he catalogued in his mathematics log (Appendix L6) include incidents of budgeting money and time to achieve desired outcomes. He mentions “determining tax” at Wal-Mart and “deciding how long” he would need to save his allowance to buy a gift. Although it is not surprising that Tyson cites explicit mathematical operations (“multiplication” and “subtraction”) as topics in his tax determination, Tyson unexpectedly makes less explicit connections of his allowance estimation (and an incident of determining Christmas gifts) to linear functions, and ratios and proportions.

In addition to budgeting money, Tyson attempts to make the best use of his time. He references “running to lunch” and “finishing a test” as incorporating concepts of time and rate. Tyson also describes “trying to hit [read: trick-or-treat at] as many houses as possible” with his brother and a friend at Halloween. He associates with this experience—as he did with “running to lunch”—notions of rate, time, and distance. In this instance, Tyson links these physical science concepts with the mathematics that is used to quantify them.

Tyson also observes mathematics and physical science principles in some of his extracurricular activities and interests. For example, he notes the significance of angles, geometry, and trigonometry in “determining where and how hard to kick [the] ball” in playing indoor soccer. Tyson also recognizes the relevance of the concepts of force, mass, and weight distribution in “determining the amount of force needing when jumping” in diving. For Tyson, the mathematics he observes is not obscured by the relevance of associated principles of physical science.

Tyson's beliefs about competence in mathematics center around both cognitive and affective dimensions. The cognitive aspects of Tyson's beliefs about mathematical competence emphasize understanding. He explains, "A student has to understand how or find ways in which you can figure out a math concept. You can get help from teachers, friends, other people—people who have a greater understanding of mathematics than you do." Tyson stresses the necessity of understanding and ingenuity in gaining and demonstrating competence in mathematics. He privileges comprehension and ingenuity over memorization. For Tyson, the nature of mathematics as a "mostly problem solving" activity encourages his appreciation of capacities to understand and solve mathematical problems: "I don't have the best memory; I don't really have a photographic memory. But I can remember how to solve something, … [without the need to] exactly memorize a certain formula for how to do something." Tyson's emphasis on understanding, in some ways, mirrors his father's sentiments. Mr. Hammer, a financial advisor, insists that competent students try "to understand—doing their best to understand the concepts."

Although the cognitive aspects of Tyson's beliefs about mathematical competence emphasize understanding, the affective dimensions highlight more motivational constructs. Tyson points to a reciprocal relationship between intrinsic motivation to learn and achieve, and success in mathematics: "It takes effort and the want to learn mathematics. 'Cause if you don't wanna learn it, you're not gonna do well. You get as much in as you get out of it." Along with effort, Tyson attributes some of the reasons a number of students do not do well in mathematics to a "lack of interest." He notes that students' motivation and affect for mathematics function as indications of their proficiency. Tyson affirms that "a student is good in mathematics, when they take joy and … great excitement in learning mathematics. You don't … learn mathematics if you're like not willing to learn it." He goes on to make another intriguing association between an affinity for mathematics and an ability in the domain, when he states:

> Both [affinity and ability] can be passed down from a parent. The liking of math can be passed down, but you still may not be good at it. But you love to do equations and calculus and all that. And then, being good at math can also be passed down from a parent who … was a mathematician and studied math concepts and created new theories.

Tyson is careful not to guarantee mathematical competence as a consequence of mathematical affinity: "You can like love math, but not be good in it." He does, however, trust that mathematical competence could be inherited from parents who display prowess in the domain: "If you hate math but … you have an ancestor who was good at math—say a mathematician—you can also be good at math, but still hate it."Tyson distinguishes that if you do not "get that [math] gene," and … you love doing math" … you can be good at math by engaging in continuous study. Tyson maintains that "you can study it enough to overcome your difficulty in math." He asserts, "You do need to work hard and continually work hard in math throughout your life to understand how to do it." For Tyson, the competent practitioner of mathematics consistently engages in explorations "to cope with everyday needs."

Some of Tyson's beliefs incorporate elements of his parents' attitudes about mathematics abilities and efforts. Although Mrs. Hammer, a realtor, endorses similar beliefs about mathematics affinity, she is less definitive about the heritability of mathematics ability:

> I do think some people have a natural affinity for math and mathematical concepts. … We all have our affinities for whatever it is we're good at or better at than others. I think too many people think that … you either have the math gene or you don't have the math gene. But I think there's some gray area in there.

Both parents are more consistent in their emphasis on effort. Mrs. Hammer distinguishes,If a student has strong math abilities, then they just need to work to their abilities, just kind of work, do what they need to do. If you have a child that does not have strong math abilities, … then they have to work a little bit harder.

Mr. Hammer privileges effort—even over grades, to some degree—and trusts that the hard work will be fruitful and productive:

> We [parents] try to continue to do a good job of just encouraging them, and praising their hard work and dedication. And it's not always, "Oh, you just – you got an A, and I'm praising that." But it's, "I know you put in the effort." … Along the way I just try to make sure that I encourage them and praise the effort. Because usually when you put in good effort, it's gonna show itself.

He also encourages their sons to "leave it on the table. If you know you worked hard, and you gave it your all, … you shouldn't be ashamed of anything." Tyson clearly fashions some of his parents' attitudes about mathematics competence into his construction(s) of his mathematics competence and self-concept beliefs.

Mathematics Self-Concept Beliefs

Tyson's links much of his mathematics self-concept with his drive to understand mathematics and with his commitment to it. Tyson's mother points outs that he has "an affinity for math" and that "historically, [he] has done very, very well." In initial conversations, Tyson is more modest about his achievements. He indicates in his mathematics journal,

> I don't characterize myself as someone who is *good* or *not good* at math or any subject (emphasis added). I believe that one's ability to excell [sic] or fail in math is due to the amount of effort given or through genetic advantages (if a parent or grandparent gave their all in math, this gene could be passed down). If I were to take great joy in learning math, by my own will and effort I can understand math better [than] most people. Thus, people say, "You're good at math." No one is "just" good at math.

In subsequent interviews, though, Tyson becomes slightly more accepting of the characterization. Yet, this acceptance is formative and appears to waver at timers: "I believe I am good at math. I like it. But sometimes, I might not be good at it. But I am still good at it most of the time." He relates his strong mathematics ability to his capacity to "understand how to do a topic or particular concepts—or, perhaps, a group of concepts—that will benefit me in some way in everyday life."Later when asked how he would describe himself, Tyson assumes a third person perspective and offers,

> [Tyson] is willing to work in any way he can for his grades. He'll accept any challenge and take it any way he can. And oftentimes he will get help from me [Tyson] or [other classmates], but he does understand the math concepts very well.

He credits having strong grades to the fact that he is “willing to work” hard to understand. He is also willing to enlist the help of his peers to achieve mastery. Tyson also hints at his appreciation of challenging material. These traits help to facilitate Tyson’s engagement in mathematics.Tyson indicates that “there was never really a point in time that I can remember where I withdrew from math.” There were periods when he found it less engaging, though. Tyson maintains that math did not interest him before pre-algebra and algebra because “there was never enough ‘complexity’ in our math concepts.” In describing his affinity for pre-algebra, Tysons explains, “I loved how, when ‘solving for x,’ I could step-by-step through problem[s], even as they got longer and harder.” In another recounting, Tyson reveals,

> I just like the idea … of solving. Like I do this, then I do this here. Then I plug this back into here like—I just like kind of complex, long, term equations that give me this minute answer, which is like the answer to like a lab or a problem.

Tyson finds satisfaction and enjoyment in doing mathematics. He explains,I enjoy it to the point where some people will be very annoyed at doing math. But typically when I do math, I don’t mind doing it. I will stay up all night doing math homework. … I mean sometimes it will annoy me. But I do enjoy math a lot. When asked how much he enjoyed mathematics, Tyson gauges “probably like an eight” on a scale from one to ten He claims that he enjoys it possibly “second most of all my classes.” He identifies “world history and any science-related subjects” as contenders for most enjoyable. However, he also clarifies that his enjoyment of mathematics varies, like a function: “It’s changed. Like I compare it to a linear—

not a linear function—possibly like a cubic function. It's gone up and down." It is difficult for Tyson to explain why he enjoys mathematics as much as he does: "I really don't know. But when I do my homework, I get a sense of relief once I solve something I don't really know how to do. So, I guess that's it." He attempts to explain his interest in a subset of irrational numbers:What attracted me the most out of the entire [eighth grade] year was (square) roots. This included addition, subtraction, multiplication, division, and factoring of roots. I guess the fact [of] using different operations and rules on roots was "crazy" yet understandable, drew me into the concept. I'm not sure how to explain it, but this concept seemed to be understandable at the same time it couldn't, and vice versa.

It appears that Tyson finds some exhilaration and empowerment in addressing the challenges of discovery whereas many other students might find the uncertainty inherent in such explorations frustrating.Tyson's history of success in academic mathematics belies the difficulties he faces in it. Tyson believes that he "had an 87 or an 88 or something" in his eighth grade mathematics class. His mother reports that he obtained an A. He finished advanced algebra and geometry during his ninth grade year "with a 90 or 91." As of the spring of the same year, Tyson's mother reports, "He does have an A in math right now. So, he's doing quite well." Tyson's interim assessment scores depict more of his intermittent struggles with the subject. He relates:

> I understand, sometimes, hard concepts on a test. I get these hard concepts right, but there are less of *those* problems. And then, there are more of easier problems, which I don't quite

> understand. So, I get those wrong, which makes my test grade really bad sometimes.

Tyson regrets that his grades may not reflect that, in his estimation, he is "doing pretty well in math because I understand the concept." Tyson expects "not just to finish my work, but understand it." Although he does not dismiss the reality of the importance of good grades, such grades are not Tyson's singular motivation: "My expectations are very high. My grade in math I would want at mid to high A. Or if I don't get it mid to high A, I know exactly what I'm doing if I was given this type of math." His mathematics self-concept is more closely tied to his sense of understanding, than from the grade(s) he hopes that understanding leads to.As he enters a pre-International Baccalaureate (IB) program in high school, Tyson finds that his mathematical confidence—though previously well established—could benefit from shoring up. He finds that "a lot of concepts in 7^{th} grade were a lot easier," and at that time he "felt more confident" about his mathematics learning. Despite his recognition of his perceived limitations, Tyson remains optimistic about his progress: "Sometimes I might get confused, or my theories may be flawed in math. And then … if I work hard enough, I can overcome and learn different strategies for how to do it." He muses, "I think math has gotten easier than last year. But it also has gotten harder. But I feel as though I'm doing better now."

Tyson attributes the strength and growth of his mathematics performance to the fact that he is "willing to accept … that I might not be able to do it. And I want to improve on my effort to understand math. And I want to get help when I need."

These insights suggest relatively keen self-perception ability for a 14-year-old student. Tysons attributions are largely linked to dispositions—a willingness to accept that the present limitations of his expanding capabilities, along with a desire to improve his efforts and understanding, and the initiative to seek out assistance. He points out that "math is one of my weaker areas, but I love to learn math." Tyson credits his " will to learn" as the thing that motivates and enables him to do well academically. Tyson's sober self-judgment regarding these attributions simultaneously reflects surrender to mathematical challenge that may exceed his present ability, combined with persistence and dedication to pursue the means to expand his comprehension.

Tyson is forthcoming about seeking help, when he needs it, in mathematics. He often finds assistance through collaborating with his peers:

> I can get help from friends almost anytime I need it, even if I'm at home, I can text and call my friends all night. We sometimes have big long calls about math homework and how to solve these concepts. So a lot of times, it would be like an hour. We stay up like half the night talking about the math concepts.

Tyson states that in his efforts to further understand mathematics concepts, he gets "help from teachers as much as I can." During the summer before he entered high school, Tyson's parents enlisted the services of a mathematics tutor for Tyson and his twin brother to supplement their classroom instruction. Tyson's mother, Mrs. Hammer, acknowledges the contribution of the tutorial—along with the individual efforts of her children—to their success in mathematics:Part of it is, of course, studying and working towards having good math grades all along, 'cause you don't just one day wake up and have great math grades. … In addition to that … [we] hired a tutor to come in and work with them. So every Sunday a tutor comes and works with them, just because we're not trying to *pass* math. We're trying to get A's in math, along with their other subjects.

Tyson's resolve to learn and understand mathematics is reinforced by his parents' insistence that he is committed to such endeavors.Tyson and his family emphasize the importance and necessity of mathematics. Much of the emphasis stems from Tyson's expressed career interests.

Tyson is interested in an engineering career and understands the relevance of mathematics attached to this choice:

> I think for me it's pretty important. 'Cause I want to major in math-related topics, like mechanical engineering and chemical engineering. So, I think it will play like a factor. 'Cause if I can't do basic algebra or basic calculus or something like that, I'm not completely sure of what I to need to learn, but if I can't do that off-hand, I probably won't be able to major in those topics and will have to re-think my life, basically.

Tyson's desire for mathematical competence is directly related to his career options. He recognizes an association between his competence in mathematics and his career and livelihood options.Tyson prepares for a succession of rigorous mathematics courses in high school and college: "As I finish high school, I am not sure what the highest math class in difficulty is, but I want to take as many math courses as I can." As Tyson focuses his attention on engineering fields and postsecondary pursuits, his mother sees his mathematics proficiency as instrumental in providing necessary advantage in the fierce competition for student positions in colleges and universities.

> High school, yes, take as much as you can. Go as far as you can, 'cause that will set you up for the schools that you probably want to go to and get accepted to. And we're thinking top tier schools, Ivy League or that first [level of] school right under Ivy League. That's where you want to go.

Constructing Competence

One of the ways the Tyson constructs his mathematics competence and self-concept beliefs is through his positioning of mathematics, self, and others. He sets math apart as a discipline in that it is "not like memorization, like all my other subjects. Tyson distinguishes that in mathematics compels him learn and "remember how to solve something, not exactly memorize a certain formula for how to do something." Although he does not reduce mathematics to the memorization of formulas, in another instance he offers a rather procedural—and formulaic—interpretation of the discipline: "Math is just do this, do that; learn this, learn that."

A degree of congruence exists in Tyson's categorization of mathematics and his characterization of himself. Tyson insists that the desire to learn is essential to the mastery of mathematics. He affirms, "Basically, I'm saying a 'brainiac' or 'nerd' would be someone who would be exciting in learning would be good at learning mathematics." Interestingly, in both of his social knowledge structures (SKS) (Appendices J11 and J12), Tyson describes himself as a "nerd." He does not view this classification in a pejorative manner. His first SKS indicates that he actually assigns to it a positive valence. In light of his evaluation of himself, therefore, is it reasonable for him to expect to demonstrate competence in learning and doing mathematics.

Also, in his mathematics autobiography Tyson predilection for complexity seems to inspire his fascination with radical expressions. He fondly describes engaging in the topic as "'crazy,' yet understandable." Tyson may find complexity in his own adolescent development. Although this characterization is speculative, Tyson includes in his first SKS the self-description "crazy." He assigns both a positive and negative valence to the adjective. Again, Tyson observes some consistencies in his descriptions and impressions of mathematics and himself. This congruence likely fortifies his mathematics self-concept.

Tyson's conceptualization of mathematics competence and his estimation of his own mathematics self-concept are also related to his positioning of his friends. He is enrolled in a pre-International Baccalaureate program. At the time of our conversations, Tyson was taking an Advance Placement (AP) human geography course. He states that many of his peers are on a similar academic track. Tyson notes that not all of his friends are as conscientious: "Some of my friends don't really care if they get B or C in math; they just want to pass the class, at least. … But many of my friends will not want to put that much effort into math." In his assessment, Tyson evaluates his effort and, perhaps, his motivation as more substantial than these friends.

Tyson positions other friends more favorably. When prompted to describe a group of more favorable friends, he mentions five individuals whom he either admires, respects, or desires to imitate (or some combination of these). No connection with mathematics was presumed or insisted upon, although Tyson may have inferred an implicit relationship. In his description of four out of five of these friends, Tyson explicitly refers to their mathematical proficiency. David has "good reading and math skills. … So, I admire that about him. And I really want to be like him." Vijai and Namdi are "good at math" and "really good at math," respectively. Namdi's nomination is interesting in that "he apparently didn't pass his previous [advanced math] grade level … last year. So, he's taking it this year." Tyson points out that Namdi does not need to take notes in class because of his understanding of "almost all the concepts." Tyson indicates that "at least one of his [friend Jerry's] parents has a master's in math or algebra," and that mathematical competence "runs though his family." Tyson acknowledges that Jerry understands most concepts "as well as David and Namdi."

Tyson does not explicitly mention the mathematical ability of the singular female whom he mentions. Instead, he emphasizes that, like Vijai, Lisa is "willing to help me whenever she can, if she understands the concepts. And a lot of times I help her. And really she gets some concepts I don't get like everyone else." Again Tyson's emphasis on comprehension is apparent. He also implies that mathematical competence is demonstrated in an individual's ability to explain mathematics to others and facilitate the understanding of others.

In many instances, Tyson also reveals his positioning of family members, especially his twin brother, Bryan. Tyson contrasts, “Bryan has [a] photographic memory, better for memorization. I can solve things better. Bryce can’t exactly do that. And I can't exactly memorize things better than he can. So, it’s kind of like we are contradicting [or complementing] each other.” Tyson sees their mathematical dispositions differently. His perspective of mathematics as a problem-solving activity makes his self-positioning as a better problem solver than his brother also a positioning of himself as possibly a more competent mathematics students. His competence, however, does not necessarily arise from—nor is it necessarily reflected in—better grades. Instead, it stems from the strength of the alignment of his problem-solving capability and the nature of mathematics as a problem-solving enterprise.

Tyson also positions African Americans along an academic and motivational continuum. When asked how he sees African Americans generally doing in mathematics, Tyson responds, “I really can’t judge, ’cause I’m not around a lot of black people at my school. But if I were to assume, I would say some do well, some do not. But the majority do not.” He distinguishes that although there are a number of African American at his school, there are “not a lot of African Americans in more accelerated classes.” When asked what factors contributed to the relative underperformance of African Americans (at least as indicated by prevalent test score data as discussion of mathematics proficiency), Tyson asserts, “It’s the will to learn. Most of *them* really don’t care about how well they’ll do in math, or why they should take that class." Tyson highlights what he believes to be a gap in motivation of African Americans and other groups that produces a gap in academic achievement.

Tyson makes subtle distinctions in his racial self-description: "I'm a Black male. Some people consider me like very small. But a lot of people consider a lot of black people very athletic and not good academic-wise, usually. I usually try to ignore that stereotype." Tyson is mindful of his self-presentation and understands that there may be prejudgments about him based on his race and gender. He identifies as a "Black male," but may view his academic success distinguishing him from other, *less motivated* African Americans. Much of his response to the interview prompt details aspects of his physicality (for example, his build and his athleticism). His description of race leads into an explication of others' considerations (Black people as athletic but "not good academically"). He does express, though, that he feels like he has been expected to do well academically as a Black male "because people see me as a small, little Black male."

Tyson negotiates his own identity formation and presentation. Through his SKS, Tyson describes himself with adjectives and nouns that—according to those who subscribe to racial stereotypes about African American academic competence—are irreconcilable. In our conversation, Tyson identifies as "Black." In his social knowledge structures, he is both an "athlete" and "intelligent." He is an anomaly of sorts. For Tyson explains,

> Black males are perceived usually to be not so much nerdy, but athletic and physically strong—not really so good at academics.

> And a lot of people, a lot of Black people—Black males, I mean—will try to get into college on a sports scholarship, or at least that's what it's believed to be.

Tyson acknowledges that a Black male's pursuit of academic competence and scholarship is not so much connected to his academic promise—whether apparent or suspected. Rather, it is often attached to his athletic prowess—however real or perceived.Tyson is, at once, a "nerd" and an "athlete" (tennis player and diver). He surrenders neither identity, and demonstrates that the two are not irreconcilable.

Over the course of my study, Tyson's interpretation of aspects of his self-characterization undergoes somewhat of a transformation. In his 2012 social knowledge structure, he assigns a positive valence to the descriptor "nerd." Yet, in his more recent 2013 structure, he gives it a negative valence. Tyson also indicates that he believes others to perceive "nerd" as negative. It is worth noting that his use of "nerd" as a self-description does not change. It is, instead, Tyson's association of this term as a positive/negative description that he modifies.

Tyson's modifications and shifts in his understanding and presentation of himself—along with his description of his self—communicates an awareness of prevalent stereotypes regarding intellectual capacity, by association, mathematical competence. Prompted by an item on the Multidisciplinary Inventory of Black Identity-teen (MIBI-t) (Scottham, Sellers, and Nguyen, 2008) addressing the perceptions of the relative intellect of Black people, Tyson responds:

> Most people don't think that [Black people are as smart as people from other races], because there's only a minority of Black people who consider themselves as smart as other people or other

> races—or could be considered as smart as other people or other races.

The stereotype of deficient intellectual capacity of African Americans is so prevalent that Tyson believes that "most people" endorse it. Moreover, he also suspects that a "most people" includes a number of Blacks individuals who also subscribe to the belief. More concerning, though, is Tyson's assertion that "only a minority of Black people" is eligible to be considered as smart either by others, or by themselves.Although the implications of stereotypes about intellect are not always apparent, Tyson's response is to "ignore that stereotype." Tyson's father concurs, "There may be perceptions and stereotypes out there, but … you don't have to live those perceptions and stereotypes." Instead, Mr. Hammer implores, "Just be you. Be outstanding." Mr. Hammer's exhortation suggests that the "you" and the "outstanding" that he encourages his children to be is antithetical to the perceptions and stereotypes of the intellectual ability of African Americans that prevail. As Tyson confronts and "ignores" disparaging stereotypes, the degree to which his beliefs (and actions) may be vulnerable to the messages in them is possibly mediated by influences of interactions with teachers, family, and peers.

Teacher Influences. Tyson attributes some of his understanding of mathematics as a result of the interest and engagement generated by his interactions with certain—or, more specifically, certain types of—teachers. He speaks very favorably about two "favorite teachers." Mrs. Leonard "took a lot of questions during the lesson and tutored us after school, if we needed extra help." When he was a fifth- and sixth-grader with Mrs. Leonard, Tyson remembers, "We did a lot of classwork, but at the same time it was intriguing to learn. … We did a lot of classwork to make sure we understood the different math concepts."

Tyson also mentions Mr. Evans as a favorite mathematics teacher. According to Tyson, Mr. Evans "would make sure we learned the concepts, and at the same time make it fun to learn those concepts." Mr. Evans's class featured "lots of student-teacher interaction and he helped us after class, if we needed it."

Mr. Evans would review problems that students had difficulty with. Also, he would give quizzes not merely to impose discipline, but to examine their comprehension of "critical concepts [that] Mr. Evans wanted us to know throughout the year."

Tyson's celebration of these teacher's serves not only as an endorsement of particular personalities (although it includes such), but it highlight's prioritizing mathematical understanding and a teacher's capacity to facilitate it. Tyson refers to Mr. Frantz, a middle school educator, "a good math teacher." Tyson states that Mr. Frantz "changed my understanding of math completely, when I took his classes." Tyson also emphasizes that Mrs. Leonard and Mr. Evans "greatly prepared" him for pre-algebra, algebra, and subsequent high school courses. Tyson stresses that Mr. Evans "wanted us to learn our concepts, which I did. For his teaching wasn't based entirely on his paycheck, but for my benefit." Tyson also maintains that Mrs. Leonard taught for his, and other students', benefit. He indicates that Mr. Evans and Mrs. Leonard helped make math attractive to him by making it "interesting and exciting." He compliments these teachers by observing, "From their teaching, I also began to realize that math could be understood by learning and studying it to the best of my ability." Although Tyson appreciates personal teacher traits, such as being "a very fun person," making "learning math fun," and relating well to kids, much of his appreciation is connected to his perception that his teachers care about him. For Tyson, this care is primarily expressed in his teachers' determination to facilitate his understanding of mathematics. And for Tyson, mathematics understanding is a central component of both mathematical competence and his own mathematics self-concept.

Family Influences. Tyson's family interactions also influence the development of his mathematics competence and self-concept beliefs. Although he actively engages in positioning his family members according to their perceived mathematics ability, Tyson also gets positioned by family members in significant ways. Both of Tyson's parents comment on their perceptions of his ability. In comparing his twin sons, Mr. Hammer notes that "math … may be easier or more natural to [Tyson]." He points out that that Tyson tested for and was admitted into the Target program in elementary school. Tyson's brother was not offered admission into the same program. Mrs. Hammer distinguishes that "Tyson's ability might be a little bit higher. And so, he's able to perform a bit better maybe. She also believes that Tyson has typically been placed in math courses that matched his ability. The early distinctions of being labeled as mathematically "gifted," "talented," or "advanced," could strengthen Tyson's conceptualization of his mathematical self.

Tyson's strong sense of his mathematical self could also be influenced by the expectations he understands his parents have for him and his brothers. Mr. Hammer expresses the importance of "making sure that they're working hard, and letting that ability from working hard show itself." Mrs. Hammer includes more specific targets in her goals for their children: "So I do have very high expectations. That's why … I'm expecting A's. I don't know what ya'll are thinking about, but we are going for the top!" She is explicit that their children's understanding of their high expectations is a "paramount issue." She affirms,

> I always say to them, "I expect great things from you. Go and be your best. Do your best. I expect great things from all three of you boys." And I've always said that. I didn't just start saying that. I've always said that."

She also explains that although the highest grade is the goal, "We don't say, 'You better get an A,' and then let them figure it out if they're struggling."The regularly scheduled visits of a mathematics tutor for Tyson and his twin provide a physical manifestation of the Hammer family's expectation of high achievement, even in the face of challenge. Enlisting the services of a tutor reflects the attention that the family gives to establishing and pursuing not only mathematical competence and excellence, but also—and perhaps more significantly-- and to developing and maintaining mathematical (and academic) diligence and perseverance.

Tyson's mother is unapologetic about the high standards and expectations she and her husband impose upon their children. As a matter of fact, she insists that African American boys, such as her sons, are particularly vulnerable to low expectations relative to other groups. Mrs. Hammer paints a dismal picture of what is generally expected of African American males:

> I think they're dealing with low expectations as a group, period, "*You* ain't no good. Your *daddy* ain't no good." So why should they try to do better, be better? Because you said, "I ain't no good, so I ain't no good." I think they have to deal with that moreso than other students.

Her comment underscores the a historical element in that generations have imposed such diminished expectations on prior generations of other "daddies." Her comment also implies that the prospects for a more encouraging outlook are discouraging and unlikely. She also discloses what she believes is a connection between the expectations of African American students and their progress:There has been a lot of nurturing, particularly of African American girls and girls in general. You know, girls can do whatever boys can do. That's been a big part of it. Boys—white and Black—are falling behind. And I think Black boys are falling behind even more, because there are no expectations for them to do anything. Mrs. Hammer sees a direct relationship between expected and demonstrated ability.Because of this, hers and her husband's standards remain high for Tyson and his brothers.

Tyson expresses the same expectation for the caliber of his work—and his work ethic—that his parents do. His expectations of himself are also "very high." He shares,

> I expect the best I can do, … with no laziness. I want to push myself harder. … I will try and do the homework, look on why and how to solve like the concepts, and get help from my teacher as much as I can.

Tyson's determination to give the best effort he can to comprehend and apply mathematical concepts is likely a combination of his individual initiative coupled with the encouragement and insistence of his parents, who make their expectations known. The strength of these expectations, along with Tyson's understanding of his parents' provision of resources to achieve them, enable him to construct a robust mathematics self-concept.*Peer Influences*. Tyson's mathematics competence and self-concept beliefs also reflect the influence of his peer interactions. His parents are aware of this powerful influence and advise their sons—as much as their development allows—to exercise discretion and caution in the company they keep. Mrs. Hammer contends, "When you talk about peers and friends and influences, I do think people around them will influence them greatly." They encourage Tyson and his brothers to be strategic in their selection of friends. Mr. Hammer shares:

> Some of the things that we talk to our kids about is be[ing] careful who you hang with, and who you talk to, and [who] you're friends with. And always try to be … around people who may be smarter than you, so that you can continue to grow. That's how we look at it.

It is interesting that Mr. Hammer urges Tyson and his brothers to seek "smarter" affiliations. This would involve engaging in positioning of peers and self along a competence continuum.

Sticking Together

Tyson appears to have heeded his parents' advice and sought and found a community of peers who value the pursuit and achievement of academic excellence. Despite some exceptions, Tyson indicates, “Most of my friends are good in math. So, that’s good.” In his first social knowledge structure (Appendix J11), Tyson referenced his self-description as a “nerd” as a positive thing:

> I think of myself as a nerd in school because … I like to work hard rather than socialize. I think of that as a good thing because that’s how I do well in school. Like I can refrain from socializing, which can make me not do well in class, which ultimately that can bring down my grade.

He associates being a “nerd” with working hard. He also contrasts this disposition with one that is more social. He finds that his persona as a nerd is conducive to his academic—and especially mathematics—achievement.Tyson also found himself in the company of many nerds before he arrived in high school. In his final interview, he points out:

> At my last school, just about everyone was considered a nerd. At this school, more of my friends … aren’t considered nerds. More like they are very social, not so much focused on school. So I wouldn’t think they would consider a nerd to be a good thing [emphasis added].

Although Tyson’s use of the term “nerd” remains part of his description of himself, the positivity he once associated with this aspect of his academic and social identity is undergoing a transformation.Tyson’s transition to a public high school brings additional change in his educational experience: “We have a new teaching and learning style. … This year it’s more student interaction because, oftentimes, we help each other with our math.” He uplifts his friends Lisa and Vijai for both their ability to understand mathematical concepts and their capacity to help him and other students. Tyson observes and positions his peers who are capable of assisting others as more mathematically competent. He describes as fairly routine the practice of seeking his peers' collaboration, "When I have trouble in math, a lot of times I get help from my friends—not so much the teacher." His mathematical identity has the strength to withstand the doubt that mathematical, conceptual, or procedural questions might impose. The doubt and insecurity that could threaten Tyson's mathematical self-concept are buffeted by fiercer initiative and motivation which he displays as he seeks to answers to his questions and edification of his self-concept.

Chapter Eight: BRYAN: Tale of the Tape

After visiting the Hammer household on occasions to speak to Bryan and his twin brother, Tyson, I discovered that despite the calm that Bryan's composure might suggest, there was abundant evidence of a hive of activity—both academic and extracurricular. This evidence presented itself almost immediately as I entered their home and sat in the first available room, the living room, where we conducted the interviews. As I waited for Bryan to arrive downstairs, I took note of the evidence before me. This was a "fine" home in a "nice" subdivision. I first observed that in this room the family had replaced any tendency toward formality and ostentation with a more casual presentation of modesty, and utilitarianism. The vase with flowers that could have served as a centerpiece was relegated to a position on the floor in the corner. Instead this potential centerpiece was supplanted by an accumulation of family members' artifacts and forget-me-nots. There were folders from school. There was a completed worksheet on quadratic expressions that would be reviewed with the math tutor who would visit the home later the same weekend. I saw Craig's binder and his Casio keyboard on the table. I noticed Mr. Hammer's basketball coach's handbook (He volunteered to assist his youngest son's team).

Another item of interest rested on the table. I took particular note of a large unframed reproduction of a famous photograph. Unlike the previously mentioned objects that served as symbols of continual, recurring activity, this artifact memorialized a specific singular event. This photograph documented the 1964 victory of Cassius Clay (Muhammad Ali) over Sonny Liston for the Boxing Heavyweight Championship title. The black and white photograph captured a moment where Ali, with a clenched right fist, towers in the ring over a knocked out and defeated Liston who lay disoriented on his back. This was Ali's second victory over Liston, but it was his first knockout (the first was a *technical* knockout).

The image confirms an indisputable victory. And one can infer from Ali's stance that he insists that witnesses—including a taunted Liston—recognize and acknowledge the triumph of his feat.

Bryan possesses a similarly competitive spirit. Although his demeanor is neither unnecessarily forceful nor combative, he makes apparent his determination to confront the obstacles he faces. On each of three occasions on which we would converse, he would look me in the eyes, greet me with a firm handshake, and share with me the following things about himself as they relate to his experiences with school mathematics.

Mathematical Competence Beliefs

Bryan's beliefs about competence in mathematics are directly related to his beliefs about mathematics and its applications. He describes mathematics in the following manners:

> I would just say it's … really similar to the sciences … like the art or science of just taking numbers … like arithmetic and all that, and expressing them into new more sophisticated problems and

> applying them to everyday life. How we can derive math forms from everyday life from just a simple transaction like going to the store and taxes and stuff and … seeing how we can use that to invent new things and explore new paths in the fields of science and engineering.

In his description, Bryan emphasizes two central attributes of mathematics. The first is that it involves the expression and solution of "new more sophisticated problems." Embedded in mathematical activity is an impetus "to invent new things and explore new paths." Although he shares the aversion of mathematics of some of his peers, unlike many of them, Bryan recognizes mathematics as a creative endeavor. He describes a person who is good in mathematics asSomeone who is really creative. … He can really think on their [sic] feet when faced with a new problem and invent a plethora of new methods and stuff to solve the problem…just really creative. Really, just when they're hit with a problem, it's just like they're in their mind a whole map of what path should I take, which paths should I take. And they can find the answer to the problem. They are the people who are always always inventing and exploring new fields and stuff, like science and medical research.

For Bryan, it is of paramount importance that the mathematically astute demonstrate a capacity to invent new methods and explore novel strategies to approach and engage in mathematical tasks. It is also significant for Bryan that these individuals possess the type of readiness that allows them to be able to accomplish these tasks "on their feet."The second attribute of mathematics that Bryan highlights points to its more practical aspects. This attribute is the very end toward which the invention and exploration that Bryan celebrates, strives—the solving of a problem. For Bryan, proficiency in mathematics requires an individual "to be pretty clever, a problem solver." He continues:

> When faced with a situation, you know how to work around it and find a solution. … So, you need to be sorta like a genius, like crafty. Say basically, an inventor who thinks of new ideas. You need to think of new ideas to solve the problem. I think that's one major thing to being competent in math.

Bryan's exemplar of mathematical competence couples often broadly-conceived craftiness with the requisite notions of insightfulness. These qualities lead to a definitive solution to a mathematical conundrum or dilemma. Pragmatism becomes tempered with ingenuity. Inspired invention is motivated by problematic circumstance(s).Bryan's mathematics log (Appendix L2) reveals practical applications of mathematics primarily in his efforts to balance both money and time. Bryan reports:

> Near in the middle of summer I was looking at jobs—just simple things like mowing lawns and stuff just to make a little extra money. And I used math to determine which job would give me the most profit and most money in a short amount of time, since school would still be starting soon and I don't really have time for that. So I just …. drew little graphs and stuff, 'cause graphs are good for determining how much money you can make in a good amount of time. Like put time, profit, just like drew a line.

Bryan states that he uses mathematics to graphically represent data and interpret these data to extrapolate which jobs offers the best opportunity to maximize his money. He also applies similar strategies to determine the best or better value in things such as buying books, candy, gifts, and supplies. Bryan reports,I was getting school supplies. I was trying to determine which is [the] best value for certain things. Like "Okay, should I get this binder or should I get this binder? Which way should be cheaper?"... And that was for a lot of stuff just visiting stores, ... using ratios and stuff to determine which would be the best value.

In addition to considering best buys, Bryan states that he uses mathematics to help him balance his schedule with the time he needed for other activities. When he began high school last year, Bryan found difficulty in reconciling his schedule to accommodate both his academic pursuits and his "extracurriculars," such as track.Bryan recounts,

> I was looking at my school schedule when school first started determining how to balance out my schedule using time logic, ratios. "If I you do this for X amount of time I can still squeeze in this." I also had to look at my track schedule, 'cause when I started track, that interfered with my school. And also when this new school year started—well, the new semester—I got a brand new schedule. So, I had [to] determine once again, which would be the best course of action to take with my schoolwork.

Bryan resorted to mathematics in order to resolve his personal time organizational conundrum.Bryan's invocation of mathematics and his realization of its applicability reflect the potential contribution of his father's influence. Bryan's father is a financial planner who was pretty good in math. It appears that he encourages his twin sons to be mindful of their available time and to be intentional in maximizing productivity within the limits of that time. Mrs. Hammer explains

> My husband did a spreadsheet, an Excel spreadsheet that kind of showed them, "In red, these are your study focus times." Yellow, I think, was the relax time; blue was extracurricular activities. In seven days a week, how [you] do fit in everything that you need to get done? And is it a red item, a blue item or a yellow item?

> And you need to put your schedule together so you know what it is you need to do, the days you need to do it, so you get it all done.

Bryan, clearly has taken his father's advice by using mathematics as a resource to plan how best to allocate his finances and distribute his time with the goals he has identified.Bryan's perceptions of mathematics shape his view about what is required to be competent in the domain. He prioritizes its usefulness in solving problems. Yet, as he describes the nature of mathematics, he assigns to it an almost frustrated complexity: "The difference about math is that there is … no explicit rules set out for you, [you] have to … think for yourself. And you're forced to like think on on your own about how you can solve the problem." He differentiates mathematics from other domains by observing, "In math it's not just like rules and regulations. Math, it's not just a fact." Therefore, for Bryan, a penchant for memorization does not necessarily facilitate competence in mathematics. Although he concedes, "You have to memorize *some* methods, like addition and subtraction," Bryan cautions that reliance on memorization—especially of notes—is insufficient in establishing or demonstrating competence. He admonishes, "You can be confronted with problems that are similar to the notes, but you have to actually start to think on your own so you can't just rely on notes."

Instead, Bryan attaches cognitive and motivational components to his profile of mathematical competence. He maintains, "To become good at math you have to be able to grasp a firm idea of the problem at hand." The ability to access and comprehend difficult ideas and situations signals mathematical competence for Bryan. He also links this capacity to comprehend with what are, for him, signs of motivation and initiative. He describes a student who is *good in math* in the following manner: "I couldn't tell just from appearance. I'd probably have to look at them as the math class progresses to see if they're intrigued, if they're always taking notes, asking questions, making sure they understand the math." Unlike his twin brother Tyson, Bryan suggests that people who are good in mathematics are likely intrigued by it. That is, they are at least curious and interested enough to insist on satisfying their understanding of it. Their motivation and intrigue are manifested in the efforts (such as taking notes and asking questions) these individuals exert.

Bryan largely centers his discussions of competence on the effort that individuals put into the study of mathematics. He asserts, "To be proficient in math, I think a student definitely needs to be dedicated. He needs to be willing to do a lot of long, hard work." Bryan acknowledges that there are some for whom "math just come[s] so natural to them." Nevertheless, he emphasizes the effort they too must exert to understand:

> It does require hard work and effort and a great amount of time—well for some people … Some people can just like knock it out in like five minutes, but they still to put in some effort in to it. They actually have to work their minds to some extent.

"Some natural talent and ability" becomes necessary "not only to succeed, but to excel in math." Bryan posits that "God gave you the potential to unlock new boundaries of your mind. You just have to put in the effort." In other words, it is through efforts, which likely include “a lot of long, hard work,” that individuals are able to access and actualize their capacity for competence and excellence in mathematics.

Mathematics Self-Concept Beliefs

In addition to his competence beliefs, Bryan also links his mathematics self-concept beliefs to his perceptions about mathematics. He believes mathematics is a disciple characterized by creativity, innovation and ingenuity. Bryan views his nature and that of mathematics as fundamentally at odds, nearly incompatible. He reflects, “I’m not as creative as some people … . And I’m just not that kind of guy. I can’t just like think on my feet. I’m not like a big inventor, or anything like that.”

Bryan also notes, “I need … to remember facts and rules. I’m very good at memorizing.” Yet, he realizes:

> You can’t just remember facts. Learning the formulas and stuff is extremely important. But once you get that, you have to take what you know from the formulas and work to solve the problem. At that point I get mental blocks. And so, I’m not that creative. I can’t really think outside of box.

In other words, mathematics demands either qualities that Bryan does not see himself possessing, such as creativity, or makes little or no use of abilities he possesses in abundance, such as memorization.Bryan’s engagement with mathematics may not be as oppositional as he contemplates it might be. For example, he explains:

> If you told me to, “Okay. You need to fix … a cracked window,” or something like that, I’d be like, “Okay. I need … a sheet that has

> steps and rules and stuff." I'm a person who uses his mind and needs to have … guidelines. I need … to remember facts and rules.

Mathematics could provide for Bryan the latitude to "use his mind" often enough within boundary of carefully prescribed guidelines. Mathematics, and many of Bryan's peers might attest, is replete with "facts and rules." Yet, when Bryan confesses this need, he does so lamenting that he has not found such abundance of facts and rules—or use for their contribution—in his mathematics experiences.Despite sharing a history of frustration in his experiences with mathematics, Bryan expresses that he is considering a career "as a medical researcher or medical doctor," focusing on genetic mutations. His interests include exploring "what goes wrong in those mutations and how can I come up with a solution, almost like a formula—to quickly analyze … mutations of a certain disease like cancer and solve it, come over to cure certain genetics diseases." Bryan's career preference is an interesting choice given the amounts and levels of mathematics in which he must engage. It is also an interesting choice when one considers the ingenuity that is expected from the individual or team of individuals as they "come up with a solution." Although he is forthcoming about his general aversion to mathematics, Bryan recognizes its value and, especially considering his career interest, appreciates the need for his competence—and excellence—in it.

Although he recognizes the importance of the discipline, Bryan sees himself as "not good" in mathematics and lacking "a natural gift for mathematics, or anything related to it." He associates much of his mathematics self-concept with his persistent struggles to understand mathematical ideas. Bryan writes in his mathematics autobiography, “Halfway through 5th grade math became a serious problem. … The main problem really was that we were constantly learning new concepts, (which I am terrible at comprehending) and I just couldn’t keep up.” During this period, Bryan remembers “not understanding math concepts. [It] was just so overwhelming for me. I just couldn’t understand the math. … Math was just a real problem.”

Much of Bryan’s discussion about his experiences with mathematics is accompanied by considerably negative affect. His fills his comments with feelings of anxiety, often as a result of his perceived incompetence or incompetence. Bryan perceives his engaging in mathematics much like an uncomfortable pairing of incompatible partners. It is, however, a relationship that must mature and endure.

Bryan writes:

> I may not like it, but that doesn’t mean I can just give up. I know mathematics will always be of great importance in my life from getting into a good college, to achieving a fantastic job, to just assessing it to everyday life. Regardless of how I feel towards mathematics, accomplishing it is a necessary part of life.

These comments are consistent with Mr. Hammer’s description of Bryan’s attitudes towards mathematics as a “necessary evil.”Bryan pinpoints the fifth grade as the time when “I first realized that I wasn’t good at math.” This was a time when Bryan struggled to understand mathematics concepts so much that he identifies it as the period when “math started to become a real problem for me.” He describes his frustration in his mathematics autobiography:

> I felt like a complete idiot and was extremely frustrated; I had never struggled with a school subject beforehand, so not only did

> I feel like I just got 100% dumber, I was also worried as I knew mathematics would be very important in my life, and here I was failing it.

Fifth grade mathematics introduces Bryan to his first academic struggle. The struggle is so intense that he had feels “100% dumber, “ and “like a complete idiot.”Bryan’s frustrations are exacerbated by the anxiety he feels knowing how important mathematics is and would become, and by the novelty and discouragement of his present failure.

Bryan’s appreciation of the importance of mathematics helps him to push through his lack of affinity for mathematics. He reflects in his mathematics autobiography:

> I was never drawn to mathematics throughout my entire life so far, but knew that doing and doing and accomplishing mathematics was a fundamental and crucial part of my schooling so I try my best when it comes to math.

Instead of serving as an impediment to his efforts, it seems that the combination of Bryan’s largely negative, cumulative affect and his understanding of the importance of mathematics serves as an impetus for him to be more determined to try hard[er] to be successful in mathematics.Despite the determination he musters, Bryan is forthright in his admission that there has never been a time when he remembers enjoying mathematics. It has more often been a subject of strife to be endured in order to achieve a greater end:

> I don’t really like math, since it’s a challenge. And naturally, when you’re faced with a challenge, you tend to hate it. So, math [has] almost always been a struggle for me. … And being a struggle, I’m determined to overcome it. But … I wish I wasn’t there. I wish I didn’t have to do this.

Part of the struggle that Bryan often refers to lies in the fact that he does not consider himself to be *good at math.* He attempts to explain in his mathematics autobiography, “When I say ‘not good’ I mean to say that I lack a natural gift for mathematics.”Bryan’s explanation highlights the need to provide more context to the portion of his mathematics self-concept that questions his mathematical competence. Bryan and his twin brother began their freshman year in the International Baccalaureate (IB) program at their high school. Despite taking “challenging” advanced courses, Bryan reports, “So far, school has not been too hard.” He also states that he “still maintained an A in my classes.” Bryan seemed to be off to a good high school start. To his parents’ disappointment, though, Bryan’s fall schedule did not include a mathematics class. Because of the block schedule configuration, he would take his math class in the spring. Bryan enjoys a slight reprieve from a scheduled mathematics course, but the reality of his mathematics enrollment in the spring reminds him that his enjoyment may be short lived. Bryan’s mathematics self-concept beliefs are reflected in the anxiety he expresses during this freshman year in high school:

> So, I’m kind of worried since I really haven’t done well in math. And I know that they will be providing with some help … but I’m still just a little worried since it’s going to be tough for math—tougher than what the normal freshmen take. Even then, I was struggling with math.

Based on the history of some of his experiences, such as the seventh and eighth grade years he describes as periods of “steady decline,” Bryan anticipates that the spring advance mathematics course would continue, if not intensify, his cycle of "struggling with math."Although he anticipates struggling with mathematics, Bryan does not retreat from engaging in the inevitable. He says frankly, "There was never an instance where I withdrew and quit from mathematics." At the same time, he has never been drawn *to* mathematics. Nor does he remember a time when he enjoyed it. Instead, Bryan relies on his work ethic and support from his teachers, family, and a tutor. In our first interview, Bryan tries to reassure himself:

> Well, we can talk with our teacher and stuff like before school hours and get some extra tutoring. I also have my tutor. And also with my parent's support, I'm sure it's going to be really hard cause this is like an accelerated program that I'm in and I really want to try hard to stay in the accelerated program. And also, … since [Tyson] is doing math this semester he might be able to give me help next semester since he already knows what happens. So, I don't think it will be all that bad.

In our next conversation, Bryan continues to be mindful of his support. Yet, he finds his optimism challenged:Since my brother is doing math right now, I've been looking at stuff that they've been doing this past [fall] semester. And a tutor's been coming over. And he's been helping me with stuff all day. So, I shouldn't have as much of problem. But I'm gonna try to go into it without feeling like I'm going to fail.

Bryan lists here some of the resources on which he is able to rely. He counts among these the support of his family. Bryan's brother, Tyson, is taking mathematics during the semester he is not. Tyson's notes and assignments serve as materials to supplement Bryan's study of mathematics. Also, a tutor visits Bryan and Tyson on Sunday afternoons during this academic school year. Bryan also lists his teacher as a resource to support his mathematics learning. Bryan's comments reveal an ongoing tension he experiences between the assurance he enjoys as he embraces the support around him, and the apprehension he feels as he revisits self-doubt and contemplates the threat of possible *failure*.Bryan's failure is closely tied to achieving certain grades and the difficulty he faces to achieve his academic goals. The standards Bryan sets for himself are often higher than those set for him by other. This appears to be the case with a number of the schools he has attended. Bryan explains, "I can't say I haven't done well in … [math], since I have always maintained a B or an A. But [it's] just a real struggle." When asked to speak to his comments about his feeling of potential failure, Bryan responds, "Well, at one point, I had like a C in math. So, I was like, 'Okay, it's going to keep going down from here.' That I was going to fail." Up to this point, Bryan has performed well in his mathematics courses.

Bryan realizes his success (at least what *others* might call "success"), yet he fights to appreciate it. He acknowledges, "I *do* struggle with math. *But* I still overcome it, and get good grades (emphasis added)." The position of the conjunction in Bryan's statement illuminates the thing(s) he emphasizes. Although Bryan acknowledges historical and present struggles with mathematics, he highlights his tendency to "overcome it." For Bryan, his victory is reflected often in "good grades."

Grades figure rather significantly in Bryan's competence and self-concept beliefs. Although he is motivated to understand mathematical principles, he is also motivated by the achievement reflected in grades. About a previous experience, Bryan writes:

> The only significant moment in math that I can recall in my life was when, just this last school year (8^{th} grade), my class and I had to give short presentations about math concepts we learned during the year. It was a pleasant experience, as I performed well and got an excellent grade.

This is the only event during our conversations that Bryan recalled with any distinguishable pride or pleasure. His pride and pleasure are rooted in a strong performance that resulted in "an excellent grade." As he refers to his fifth grade year when "math became a serious problem," Bryan reports, "I began to really struggle with my grades." In addressing how he feels about his math grades, Bryan comments, "I always think that I can improve them." He trusts that the improvement he looks forward to will come from the strength of his efforts and assistance from tutoring.Despite expressing an interest in a medical career, Bryan does not necessarily look forward to the certainly of having to take more advanced courses. He is willing to consider enrolling in additional advanced classes such as AP Calculus only "to the extent where I need to pass certain courses in high school and get certain readiness courses to go to [the] college of my choice that specializes moreso in the field of medicine and medical studies." In other words, he would commit to such a decision "if it was needed to pursue my interest(s)." Bryan implicates his understanding of his strengths (and perceived weaknesses) and his own motivation toward and away from them as being primarily responsible for his lack of interest in engaging more and higher levels of advanced mathematics. He states that that he would prefer to "focus on other stuff, like learning more languages." When asked why he was not eager to enroll in more advanced courses, Bryan responds, "I guess it's not easy to answer, but it's actually too hard. I bet I could, if I wanted to. But I just don't. I want to spend my efforts on the other stuff that I am more gifted at." He accepts that mathematics is, for him, a difficult subject that fails to instill in him any special interest outside of its instrumentality in moving him further along in the direction of his academic and professional goals.

Although Bryan admits to struggling with mathematics, his goal remains to establish and maintain strong performances in his courses. He shares,

> [I expect] to, despite the struggle, achieve good grades in math like a high B or an A. That's what I want in math. And that's what I really need to get in math, if I want to have future big college prospects. ... I'm definitely trying to go for an A in math.

Bryan counters potentially detrimental effects of emotions such as anxiety and apprehension with a commitment to confronting and overcoming them. His commitment to overcoming, though, is more than a mantra framed by lofty, yet empty, rhetoric. Instead, it is an anthem anchored in dedicated and dogged persistence. These traits help distinguish Bryan in the eyes others as diligent and capable; and in his own eyes, as necessarily triumphant. He believes that his victories have been and will be the fruit of his determined efforts. Bryan's self-conceptualization as personally and academically diligent and determined serves to buoy his wavering efficacy regarding his mathematical performances.

Constructing Competence

Bryan constructs his mathematics competence and self-concept beliefs in multiple ways. His beliefs reflect the most significant influence from interactions with teachers, family, and peers. Bryan is aware of the expectations that he believes these groups have for him. He often adopts these expectations as his own. At other times, he chooses to reject them. He positions mathematics as a domain demanding certain characteristics compatible with the nature of mathematics. He identifies and positions himself in certain *other* ways that sometimes estrange him to mathematics. His identity as an African American/Black male serves to motivate Bryan all the more to achieve, in some ways to dispel the negative stereotypes regarding the intellectual, particularly mathematical, ability of African Americans.

Teacher Interactions. Bryan's competence and self-concept beliefs show signs of being influenced by his interactions with his teachers. Bryan finds support for his mathematics self-concept in the kindness and warmth of two exemplary teachers. He fondly remembers his fifth grade teacher, Mrs. Leonard, and his seventh grade teacher, Mr. Evans, as "the two best math teachers I've ever had." Bryan distinguishes these teachers as being able to inspire his perseverance:

> What discerned them from other teachers was no doubt their perfect balance of discipline and fun in the classes that they maintained and the forever enduring encouragement and help they gave us. With their help, I was able to persevere through the years.

Furthermore, Bryan compliments the personalities of his favorite mathematics teachers and values the classroom environment that they helped to establish:It was amazing learning from the two of them, despite my struggles in math; they were both very friendly and encouraging, and always pushing me on, always made the classes fun. Though like any good teacher, they still kept the class in control and discipline, and could be strict.

Bryan foregrounds teachers' ability to manage an environment that is supportive and encouraging, yet disciplined and structured for their students.Bryan especially appreciates the lengths to which he feels Mrs. Leonard and Mr. Evans went in order to assist him. He remembers in his mathematics autobiography, "After all, it was Mrs. Leonard who happily volunteered to tutor me when she saw that I was struggling and Mr. Evans who helped me push through to the end with a good grade." About Mrs. Leonard, Bryan recalls that "she was willing to take time from her life to help me. She was extremely generous, … just very nice and caring." And although Mr. Evans "didn't have as much time" for tutoring, "he was still a really good teacher" who was "always trying to help." Bryan most fundamentally appreciates these teachers ability to teach mathematics. But he particularly values the support they gave to his mathematics self-concept as reflected in their dedication to his understanding. It is their dedication and his tenacity that combine to strengthen his mathematics self-beliefs.

The development of Bryan's mathematical self-concept is revealed in some degree in his interpretation of his teachers' expectations of him. He remembers,

> "They expected *all* the kids to [do well in mathematics]. … So, more so she just wanted all the kids to be good at math. So, it was normal. She wasn't putting any real expectations for me—any specific thing—like *you* do well [emphasis added].

He does not see his teachers differentiating expectations of him that were in any way different from other students. No more or less was expected of him. He finds that in middle school, his teachers (Mrs. Leonard and Mr. Evans) were "very aware" of the struggle he was feeling with mathematics. Yet, they "really had high hopes for me to do well." When asked whether he believes his current high school teachers would encourage him to take advanced mathematics courses, Bryan speculates,They like want the best for me—to say, "Yeah, this advanced math thing is a good thing." But I think they would still have like their restraints like, "Bryce wasn't that good in math." So, … they'd want to take some caution and stuff.
It is during this most recent phase that Bryan first expresses any concerns that teachers may have reservations about his mathematical acumen. These teachers'reservations about Bryan's proficiency may, indeed, be projections of his own.

Family Interactions. Bryan incorporates elements from his interactions with his family into his mathematics self-concept. His home environment provides asylum from many of the potentially pernicious assaults on his mathematical self-beliefs. Bryan is forthcoming that his parents are responsible for this physical and psychological support. He summarizes the dynamics of his interactions with his parents:

> They are always giving me support telling me I can't really like I shouldn't give up, [and] just let it dominate me. 'Cause that's just really pathetic. They've given me support and advice—try and give me help with math and try to get me tutors and stuff. They've always been a great help with math.

His parents make available for him material resources, such as tutors and academic supplements. They also offer Bryan mental resources in the form of advice and encouragement to persist and excel.A more in-depth review of Bryan's statement further reveals the nature of the support his parents provide. Bryan first points out the mental support he receives from his mother and father. His parents are instrumental in fostering in Bryan the motivation to achieve in the midst of circumstances that he does not enjoy. Mr. Hammer explains his and his wife's roles as parents to Bryan and his brothers in the following manner:

> I would say to encourage, to coach, to help develop, to be in their world so you can understand what is going on, and what they like, … what they dislike, and where they may be having challenges—and understanding where they may need some help so they can achieve, and feel comfortable and confident in their abilities.

Mr. Hammer sees himself as an encourager and an advisor. He also views himself—and, especially, the math tutor—as a surrogate coach. He asks rhetorically, "You have a coach that helps you in tennis, or track, or whatever the case may be. What's wrong with having an academic coach for this one particular topic or another?" Bryan's parents make no apologies for their expectations, which "have been high." His mother insists though, "We've always been right there beside them to help and assist them, and help them to be their best. She affirms that they intend to help their children as they strive to achieve.Bryan's father recounts an incident that demonstrates their parental and family commitment to solidarity in the effort to achieve in mathematics.

> Bryce was online. And they can go online, and see what their scores are on tests … . And you can always tell when something's going on with Bryce. He wears his emotions on his sleeve. So, he comes in the room and he's like, "That last math test, … I didn't do as well as I thought. … This is 16 percent of my grade." I said, "Well, that's good. Winners keep score." So, he knows exactly where he is. … "You have an opportunity to go in earlier because the teacher makes himself available." So I said, … "There was definitely a disconnect, because you thought you did well and you didn't. … Your brother just had the class last semester. So, come back home [and] we'll figure it out."

This incident provides insight into the dynamics of the Hammer household. It shows that Bryan is comfortable enough to share difficulties and disappointments he experiences in his mathematics class. Mathematics performance matters to him. And it appears that how he feels about his performance also matters. Bryan expresses his concern about the weight of a particularly disappointing assessment performance. Also apparent in his father's response is the Hammer's consideration of the details of these assessments. His response suggests that these details (evaluations of "where he is") allow for more focused attention to improve. Mr. Hammer's final comment indicates that Bryan's struggles are not his alone. That is, the family assumes responsibility in helping Bryan and his siblings to overcome and to feel as if they will overcome. Although Mrs. Hammer asserts that mathematics is "Something they're gonna have to do, something that they need to do," she also reassures Bryan that it is "Something that we're gonna work *with* you on." Bryan's parents identity his twin brother, Tyson, who had taken the course, as an additional familial and academic resource. Bryan's father reinforces the notion that Bryan must adopt a certain psychology of strength and resilience: "You have to have that mental toughness too, … 'I can do it'. So, tomorrow's a new day. And let's figure out what's going on. And let's make it happen."One of the things that the Hammer household aims to make happen is that strong academic performances are accompanied by at least an equally strong sense of confidence in self and abilities. Mr. Hammer indicates that one of the reasons that they provided a weekend tutor for their twin sons was "for Bryan to build up his confidence." Mr. Hammer explains that he views the tutorials as "additional coaching sessions." The Hammers implemented Sunday tutorials during a time when Bryan was not enrolled in mathematics "to keep his math skills up." Mrs. Hammer explains

> So, him not having math, he is just cruising. So, while it's extra work, I think he does appreciate it because he knows if he does have math and then he had all this other work to do, it would be difficult for him. … He knows how important that is. And he doesn't want to start math, when he *does* start math, and be like, "Oh God, I forgot everything." So, he was receptive to it. Does he like it? Probably not. But he doesn't have a choice, because he knows what the expectations are.

Mr. Hammer attributes Bryan's positive reception to the idea of having mathematics tutorials to his "competitive" nature:He was 100 percent receptive. Because with him and his personality, he—I think just being competitive, he wanted to make sure that … when he took that class, that his confidence was up. So, I think he's the type … he'll work hard to get there. And so, he was totally receptive.

The competition comes into play not only in Bryan's mathematics classroom, but also to some degree in his household. Bryans father acknowledges, "[Bryan] tends to do well, but it's that apprehension. It's like, 'This may be challenging for me. … I know this comes more naturally for my brother.' So, I think there's that sibling competition that's just there." Bryan's mother speculates that the more favorable relationship with mathematics that his twin brother, Tyson, enjoy adds a degree of pressure for Bryan to do well:[Bryan] likes to be the best. So, while I don't think that he thinks, "My brother shouldn't be as good," or "I should be better than him," I definitely think since they've come along the same path and his brother is one way in math and he's another, he probably puts pressure on himself about that, just simply because of his competitive nature—for the most part.

Both parents point out that Bryan suffers in that "he wants everything to be perfect." Perfection, though, is a merciless standard that can often challenge an individual's sense of competence.Bryan, however, identifies a different source of pressure that he has come to understand, and accept and in some ways, internalize. In commenting about his parents, Bryan states:

> They always pressure me to do well in school. … When I was younger, of course I didn't really understand why. But I was like, "Okay. This makes my mom and dad happy, so I should probably do it." But now, I realize how important it is.

Bryan suggests that as he realized the importance of mathematics, he began to accept the parental "pressure" to do well in school. His parents are "working with him" to impress upon him, "You need … not be perfect. You might be that student who is a B+/low A-student in math. And that's okay." They are concerned at this point that "He doesn't believe that's okay. Not okay for *him*."*Peer Interactions.* The strength of the contributions of Bryan's parents to his mathematics self-concept is also observed in his parents' consideration of the influence of peers. Mrs. Hammer believes that "friends definitely play a role" in how a students perceives their own ability. She indicates that she and her husband are very intentional in surrounding Bryan and his brothers with peers who are likewise motivated. Mrs. Hammer notes, "Not that I choose my children's friends, but I try to put my kids in environments where there are kids that are like minded, meaning that they're trying to do well in school." She stresses that she sought for her sons " an environment that was going to be high achieving and kids doing things that might have been out of the box for them. ... That was by design." Mr. Hammer points out that Bryan and Tyson have begun a "rigorous program" where "a lot of kids come ... from that same level of student achievement." He states that he admonishes his sons, "Be careful who you hang with, and who you talk to, and you're friends with. And always be ... around people who may be smarter than you, so that you can continue to grow." In other words, despite the vast majority of competitive student Bryan may find with him in his classes, he is urged to associate—though not necessarily exclusively—with "people floating to the top."

Bryan's competitive spirits surfaces in his relationships with peers. He recollects, "I was jealous of ... one of my friends. He was like always getting really, really good grades with everything, like always beating me." Although Bryan has typically achieved exception grades in his other courses, mathematics challenges his record of exceptional performance. Bryan comments about his friends: "Some of my friends are like really gifted in math, and some are just like gifted all around. They're like just extremely intelligent in all subjects." In this early interview, Bryan positions his friends in two categories, both of which are "gifted." He observes though that “all of them started around my age, my level in math concept and understanding.” His words simultaneously position his own ability as something different from these “gifted” peers, and offer hope for the levels of competence that he could acquire.

Under the influence of his peer associations, Bryan’s mathematics self-concept continues to evolve. Later in the school year, Bryan witnesses some of his friends beginning to struggle with mathematics. At this time, Bryan begin to view his competence as more commensurate with that of his peers:

> Some [of my friends] are struggling in math right now. Some are okay with it. Only like two of my friends …[are] excelling in it. So, for the most part, … I would say my math skills are equal to my friends.

Bryan’s estimation of his mathematics proficiency shifts from that of underachieving relative to his peers, to one that is relatively consistent with them. Bryan’s mother insists that “[Bryan] is better than he thinks he is. He’s just not as good as he thinks he should be.” She continues, “He probably does better than 95% of the kids in school. But because he’s not doing if the way he wants to do it, he’s building up apprehension in himself.” Regardless of the disparity Mrs. Hammer perceives, it is likely that Bryan shares solidarity with his “struggling” friends as a result of the difficulties he and they feel mathematics introduces.Bryan’s social relationships do not revolve around mathematics or his friends’ explicit connections to the domain. Although he clearly respects his peers who are able to comprehend mathematical concepts, engage in mathematics, and perform at high levels, Bryan does not hold these traits as central to his social circle. In enumerating friends whom he admired, Bryan lists their athletic ability more often than their academic proficiency. Out of the seven friends he mentions, three of them are “good at soccer.” Another is “good at football.” Bryan also admires the “creative drawing abilities” of two other classmates. He also praises what he deems as admirable qualities of another two of these seven friends: one is a “good sport,” and a “good friend”; another is “kind of like a saint.” The last friend that Bryan talks about, he describes as “worthy of imitation” because he is a “really pretty social guy” who is “pretty funny.” So, although Bryan believes in the significance of academic and mathematics competence and the determined pursuit of them, he values the qualities of athletic prowess and personal character as centrally important—at least in the selection and esteem of his friendships.

Positioning, Identification, and Identity. Bryan seems to arrive at his conceptualizations of mathematics competence and his self-beliefs by positioning mathematics and himself, relative to his views of mathematics. He also identifies himself in particular ways that undergo shifts and transformations over time. As he continues to engage in school mathematics, the shifts he experiences amplify and/or attenuate his developing mathematics self-concept beliefs. Bryan also engages in social comparison of his own perceived ability in relation to that of others, such as his peers and his twin brother. As he embraces his racial identity as an African American male, he comes to wrestle with his understanding of diminished expectations that he is discovering is leveled against this group.

Through such acts of positioning and identification, Bryan constructs his beliefs about mathematics, mathematics competence, and his mathematics self.

Bryan positions mathematics in two principal ways. First, it is a discipline that requires creativity and ingenuity—characteristics he sees himself as lacking. Second, mathematics is, for him, the subject that challenges his abilities most. During the spring semester, Bryan earned an "A" in all classes—including an Advanced Placement (AP) course—with the exception of his mathematics course. He maintains that his ability is stronger in all other subjects. Despite Bryan ending his first high school year with a 4.25 grade point average (GPA), he seemed pained to share with me that he received an 85 in his mathematics course. Bryan views mathematics as his Waterloo.

Some of the ways that Bryan positions himself are reflected in shifts in his evaluations of himself on the Self-Description Questionnaire (SDQ-II). The SDQ-II uses Likert-style items to assess individuals' self-beliefs, especially self-conceptualizations. Responses vary from 1 (Not at all like me) to 6 (Very much like me). Bryan's shifts on responses to items from 2011 to 2012 (Appendix O2) reflect his feelings of anxiety and apprehension regarding academic mathematics. In response to the prompt about getting good grades in mathematics, Bryan goes from a six in 2011 to a four in 2012. Bryan finds it more difficult to achieve the same level of high mathematics grades to which he had grown accustomed. Bryan agrees more that he "has trouble understanding anything with mathematics in it" [3 (2011) to 5 (2012)]. He reports that he more "often need[s] help in mathematics" (from 4 to 6). His recent SDQ-II illustrates that he less often "look[s] forward to mathematics classes" and hardly "enjoy[s] studying mathematics." Bryan's responses to each of these items diminished from three to one. He attributes much of the heightened anxiety and apprehension that these shifts indicate to the fact that his mathematics rigor "definitely started to pick up more in the intensity this year than the last one." The difficulty that he experienced this past year confirms to some degree for Bryan a less enjoyable affective experience with academic mathematics. This less enjoyable experience, consequently, engenders a less efficacious mathematical disposition.

In addition to being influenced by the ways he positions himself relative to the discipline of mathematics, Bryan's mathematic self-beliefs are shaped by his positioning of his perceived competence relative to the competence of his brother, Tyson.

> Once you have a problem, you have to be creative and use ingenuity to solve the problem. I struggle with that trying to force my brain to think outside the box to get rid of that problem. I don't think [Tyson's] had as much trouble doing that. He's always been more creative. He's like a builder and stuff. He is better at math.

Bryan views mathematics as a domain of creativity an ingenuity. Since he views himself as relatively deficient in these traits, Bryan reasons that he is less mathematically inclined. And since Tyson seems to possess these characteristics in greater abundance (i.e., "more creative"), Bryan positions him as "better at math."Closely associated with the multiple ways Bryan positions himself and others in relation to mathematics are the ways he identifies himself in relation to multiple groups. One of these ways is through his racial identification. Bryan states, “Racially I describe myself as basically Black.” He also points out that although he believes “other people would describe me more so [as] Black,” he qualifies, “I think some people would have different views, since I am light skin[ned].” But, for the most part, ... I would say [that I am] Black. His statements allude to his understanding of the existence of long-standing stereotypes and biases based on [shades of] skin color.

Bryan assumes, with both pride and indignation, a responsibility to combat, if not confront negative stereotype about the intellectual capacity of African Americans, particularly in the area of mathematics. Although his racial awareness does not preoccupy his present consciousness, it has become more salient in his academic progression. Bryan pinpoints the time of his heightening awareness as

Bryan points out the he “didn’t really care” about race until “around eight or nine:”

> I had White friends, friends of different races. ... So, I never really paid attention to my race. I was just like, “Okay. I’m Black. So what?” But now as I’m starting to get into more accelerated studies ... I’m like, “Okay.” ... There have been wars since people can’t get along with each other because of their race or ethnicity or whatever. So now, I really identify myself: I’m Black. Therefore, people think I probably can’t do as well as others. So I’m gonna prove that I can.

As Bryan progresses along accelerated academic trajectories, he is finding that “there aren’t as many African American males in my classes as others.” Bryan has pondered, “I’m one of the ... few Black kids doing well [academically]. ... Why am I all alone here?” Although Bryan does not feel that being an African American

(Black) male has directly affected his educational experiences, he concedes, "It gives me the drive to say, "Okay. Let me just show the world that not African Americans or not all Blacks are bad at academics. I can do this. I can excel and become very successful." He feels driven to prove that he is "not like all the others who drop out and stuff."Bryan also hints at the potential influence of the expectations of others in the construction of competence beliefs—those possessed of the individual, and those of other people *about* an individual, or groups of individuals, such as African Americans. Bryan maintains that in his last schools which had "a lot of Black students…who were struggling academically," he had "a feeling my teachers didn't necessarily expect them to do all that well." In light of the diminished expectations of these African American, Bryan contemplates, "Yeah, maybe it is tough to be Black." When he asserts that "African Americans are generally not the best at academics and they struggle the most with math," he attributes the following as possible explanations for his claim: "Most African Americans are poor or have family issues at home. Their parents are in bad financial situations or bad physical situations." Bryan foregrounds economic conditions in his discussion of the academic status of African Americans as a whole. Bryan continues, "They may be … addicted to drug or alcohol or something. They don't help their kids. Their kids start to develop negative things. They don't really care about anything." Bryan suggests that dismal economic and social conditions combine to produce an unsupportive environment. This unsupportive environment manifests itself through (academically) unmotivated individuals and families within the African American community. When contemplating the [in]accuracies embedded in his comments, it is important to consider *what* or *who* informs Bryan's portrait of (this portion of) African American academic experience. It is also important, however, to understand that regardless of the accuracy of his commentary, the beliefs help to fuel Bryan's determination to counteract narratives that he may only be beginning to interrogate as his mathematics self-concept evolves.

A Fighting Chance

In spite of the diminished expectations Bryan recognizes people may have of him as an African American (Black) individual, he is, to some degree, buoyed by the elevated expectations his parents have of him as their son. Bryan infuses his parents' expectations of him with his own as he wrestles against the challenges of prevalent stereotypes and biases. Bryan posits:

> I think people still have the notion … that Blacks just aren't as smart as other races, … but it's like going away. Some people are just like saying, "Okay. They're Black. They have just as much – they're equal to us. They have just as much a chance as any of us as becoming proficient in academics."

His historically professed consistent difficulties with mathematics are compounded by an equally persistent dilemma to confront his own struggles not to succumb to deficit ideologies regarding the intellectual competence of African Americans, or to subscribe to them.As Clay (Ali) did for Liston 50 years ago, Bryan prepares for yet another battle with a most formidable opponent. Just as Liston was known as "The Big Bear," mathematics for Bryan is a beast of a foe, not to be overcome in a single encounter. And while history has confirmed the outcome of the 1964 match, the conclusion of Bryan's battles with mathematics is yet to be written. And as his parents disclose, much of his battle is not so much exclusively against mathematics, mathematics pedagogy, or the assessments that proliferate within it. Bryan faces a more formidable challenger in the mirror.

Bryan is a fierce competitor, though, keenly aware of where his *training* should focus. The "coaching" that he receives from his tutorials, teachers, family, and peers strengthens his resolve to persist and excel in mathematics. In establishing his mathematics self-concept, Bryan has learned and continues to learn

> [To] become more mentally tough, to … become more driven, more focused, more determined … to be willing to do hard work and know that at the end there's gonna be a reward. … So, [en]vision a goal and develop the mental strength to drive for it and get to achieve that goal.

Bryan's comments affirm his beliefs in the fruits of his diligence and his resilience in the face of difficulty as he experiences mathematics.

Chapter Nine:
GABOUREY: "It's Starting To Click In My Head!"

On my final visit to the Watkins household, I decided that I would ask Gabourey describe herself with a graphical representation called a social knowledge structure (SKS). She had completed an SKS before the end of the first interview months before. Among the descriptors she used to characterize herself on the first administration of the SKS (Appendix J5), were "flex[i]ble," "funny," "friendly," "pretty," "sensitive," and "smart." The SKS that Gabourey completed during the final interview included a number of consistent descriptions ("funny," "pretty," "friend"). Gabourey also added a new adjective to her list of descriptors. I would have to help her with her articulation and spelling of the word (I presumed) she meant to use: "genial." Based on the personality that I had come to know better and her emphasis on describing herself as a "friend" or as "friendly," I suspected that "genial" could be the appropriate choice that she sought. As she wrote on the paper I had provided, though, she had unsuspectingly inserted a "t" between the consecutive vowels of the word. With the best poker face that I could manage, I asked Gabourey to get her father. I am not certain of my motivation in requesting Mr. Watkins I had no idea what I should do. This was a contingency that I had not anticipated. How would I be expected to document it? Who would have to know? Was I overreacting? Was I underreacting? Also, I had come to recognize the protective responsibility that Mr. Watkins assumes for his family. I also respected the access that he and his wife had grown to allow me. He would have to know. When I told him what I had asked of Gabourey and showed him what she had written, he and I both blushed as we restrained our adolescent, embarrassed smiles. After Gabourey explained what she meant by the word she had written, her father and I agreed that the word that she sought was most likely "genial."

This episode, with its awkward and uncomfortable moments, reveals information about how Gabourey understands herself and how her family interacts and protects her. In the seventh grade, Gabourey is the youngest participant in this study. She is also the youngest of four children. She, like her next older brother, is diminutive in stature. She wears glasses and often, but not always, wears her hair in braids that extend beyond her shoulders. Gabourey is well spoken, responsive, and expressive—careful to understand and answer questions posed to her. She is deliberate in her speech and subtly conveys the kind of strength that belies the tendency to want to protect her. Her father and I had shielded her from the potential embarrassment of the episode, but this would not be the singular incident where I would witness such familial protection.

Other incidents and conversations suggested that Gabourey's innocence was protected and preserved for as long as it needed to be in her parents' estimation. For example, as I had just received the news of the Aurora, Colorado movie theater shooting and sharing my alarm with Gabourey's father, I detected an unspoken cue from a subtle glance from her father that the details of this conversation would not proceed in her presence. On another occasion, Gabourey's mother would tell me that she would circumnavigate—or at least postpone—a discussion of alternate lifestyles that she would more likely be forced to have, if they had chosen a different private school for Gabourey. It was if Mrs. Watkins's was attempting to keep Gabourey's experiences more traditional, and *uncomplicated*—if that is at all possible.

"Traditional" and "uncomplicated" was the impression of Gabourey's household I formed as a guest. Mr. Watkins, Gabourey's father, is a social worker with a Masters of Divinity degree. He spoke calmly, yet decisively. Mrs. Watkins, Gabourey's mother is an accountant. She attended to more of the details of the household mechanics (coordinating schedules, rides, school appointments). A small garden grew in the rear of the house from which I would be offered green tomatoes, and sweet potatoes. After my final interview, I would meet "Big Momma," Gabourey's grandmother who had just moved in from Texas. I would take with me pears, peaches, and green beans that she had canned.

Despite the southern and familial comfort provided by her family, as with every adolescent, Gabourey would face the difficult task of carving out her beliefs about herself. She could not be shielded from all the assaults to her self-concept. Instead as Gabourey enters and interacts with environments different from her home, she fashions—as all adolescents must—her ideas about her self mathematics identity, her mathematics competence, and her self-concept beliefs.

Mathematical Competence Beliefs

For Gabourey, understanding and knowledge evince the intelligence that is essential to her profile of mathematics competence. She emphasizes that effort and are important in deepening mathematical understanding. Yet, Gabourey also posits that some are more naturally inclined to do well in mathematics. In some ways, she minimizes the role of memorization yet she recognizes speed of execution as a manifestation of mathematical proficiency.

Gabourey explains that being *good* in mathematics "takes intelligence, and maybe some patience, and some memory. She clarifies that "it's not memorizing. It's more of getting it and like understanding it and … more sinking it in." Gabourey prioritizes comprehension and emphasizes it as an indicator of intelligence. She further explains:

> In math … you can't just memorize it. You gotta actually endure it and learn it and have it sink in and have you remember it in like a couple of years. But with memorizing something in math, if you just memorize it, a couple of years later you won't be able to like talk about it and explain it. But if you actually know it and if you actually have learned it—learning it instead of memorizing it—you'll be able to explain to that person a few years after.

Gabourey's explanation makes a number of distinctions. First, learning and knowledge are central to her notions of mathematical competence. Second, such learning and knowledge prove to be sustainable, accessible beyond the moment's need. Third, the learning and knowledge take on a social dimension. That is, it becomes necessary to "talk about it and explain it" to others in the present and/or the future. Through her language syntax, Gabourey subtly distinguishes mathematics as an agent which, with its weightiness, has to "sink in." Yet, the individual is also an agent who must "endure," "learn," and "remember" mathematics over time. Mathematics is the object of cognitive engagement through which one must persist.Gabourey suggests, though, that some individuals are more naturally predisposed to mathematics. She posits, "Sometimes people don't really need to work at all, if they just get it." Although in some ways she espouses natural ability beliefs, Gabourey privileges effort and hard work as necessary either to compensate for mathematical ability assessed as insufficient or to further develop and augment mathematical proficiency that may already be evaluated as "competent." Gabourey

affirms, "All you need is a little bit more practice and you just need to study a bit more hard than the people who do have a gift for math." Her emphasis on effort is also expressed as she points out, "If everybody tries hard and they don't get it, but they give it their all … there's nothing you can do about it. But at least they tried."

Gabourey points out that the nature of mathematics may frustrate routine efforts to study content. She contrasts the *ineffectiveness* of studying (for) mathematics with preparing for other subjects:

> If you're studying for a science test, you would reread the chapters in your science textbook or something. But in math every problem is different. So, you can't really study like one specific problem because there can be … a lot of different varieties of problems. So, you can practice, you can give yourself practice problems. … I mean, you can study the terminology, but you can't study the actual problems because they can be different

> on the test. Whereas, if you're studying a science problem, then that same question that's in the book can be on the test.

Gabourey does not see the value of studying "actual problems," since these problems might not occur on the assessment. Instead, she finds it reasonable to study problems that are identical to test items. Gabourey appears to conflate studying mathematics with memorizing mathematical terminology and procedures. She also encourages the study and practice of "different varieties of problems." Perhaps, for Gabourey, it is in the multiplicity of practiced problems that she finds value. Gabourey implies that speed of execution may be indicative of mathematical competence. She claims that the stronger math students "get it faster than others, if we're taking a test or something and they turn in their test first. ...They're always answering, always being the first person to answer a question." So, Gabourey's profile of mathematical competence components includes answering questions and suggests that it conveys particular acumen to answer questions and complete assignment and assessments relatively quickly. Gabourey describes students with this ability in the following manner: "If somebody turns it in first, ... it just means that they get it more and ... they already have the concept." The promptness of students' submissions suggests to Gabourey that they grasp available mathematical concepts.

However, Gabourey also downplays the importance and relevance of speed to mathematical competence. She distinguishes, "Some people might not get it faster than others. So they need a little time for it to stick in their brain." It simply may take longer to perform certain mathematical tasks or to arrive at certain levels of proficiency. Gabourey also makes it clear that she prefers "to get my questions correct," rather than answering questions more quickly. Although she recognizes that there may be practical benefits associated with completing assignments expeditiously (e.g., time constraints, academic competitions), she values accuracy at least as much as speed: "I don't think speed really matters unless you're playing a game. … Then you would need to be fast, but still get it right."

Although she appears to be on both sides of the discussion about the relevance of speed in mathematical competence, Gabourey is unequivocal in emphasizing the importance and ubiquity of mathematics. She describes mathematics as "numbers and variables … questions." Gabourey asserts that math is "very useful," and that "math is in almost everything. So, you have to learn it." She includes "working at fast food places, engineering, teaching, business workers, accountants, librarians, [and] almost everybody—or almost every job" as using mathematics. However, it is worth noting that she neglects to mention the careers of her own interest (interior decorating, real estate, acting). The relevance of mathematics and mathematics competence may not be as apparent to her in her personal interests.

In her mathematics log (Appendix L3), though, Gabourey connects several of her activities (setting the table, making purchases, packing clothes) to mathematics. The connection she recognizes is largely the addition, subtraction, and multiplication that serve to determine "how many" items or occurrences of particular phenomena. Gabourey notes this type of occasion in five of the ten experiences she lists from her daily life. In other incidents and activities, Gabourey engaged in comparative strategies that involved proportional reasoning (best buy, speed limit, "what percent of people in my group memorized their script"). Her understanding of mathematics as important and interwoven into the fabric of many of her daily activities helps impress upon Gabourey the significance of mathematical competence and encourages her to consider her own.

Mathematics Self-Concept Beliefs

During the pilot study, Gabourey explained that the thought that came to mind when thinking about mathematics was "kind of like 'downfall,' because I'm really not that good at math." At that point, Gabourey was beginning her sixth grade year. Nearly a year and a half later, after completing the fall semester of her seventh grade year at an independent school, Gaborey is beginning to look at mathematics and her experiences with it more favorably. The shifts that occur in Gabourey's attitudes and feelings reveal a great deal about the development of her self-concept beliefs.

Gabourey's responses on the Self-Description Questionnaire (SDQ-II) (Marsh, 1990) document her transforming mathematics self-beliefs. The 102-item instrument has 10 questions specifically about mathematics self-concept. Individuals respond using a 6-point Likert scale to describe how much a statement is very much unlike them (1) or very much like them (6). Gabourey's choice on four of the mathematics self-concept items remained the same between the year that separated SDQ-II administrations (Appendix O3). These items were *I often need help in mathematics* (5), *I have trouble understanding anything with mathematics in* *it* (4), *I never want to take another mathematics course* (1), and *I enjoy studying mathematics* (3). Her response to two items increased by one unit: *Mathematics is one of my best subjects* (2 to 3), and *I get good marks [grades] in mathematics* (3 to 4). On the second administration of the SDQ-II, Gabourey indicated even more substantial changes in items that included *I look forward to mathematics classes* (1 to 3), *I do badly in tests of mathematics* (4 to 2), *I have always done well in mathematics* (1 to 3), and *I hate mathematics* (4 to 1). These changes in Gabourey's responses are encouraging and indicate a shift in her self-perceptions in the direction of a stronger mathematics self-concept.

The changes in her SDQ-II responses warrant further qualitative investigation to more fully illuminate into Gabourey's developing mathematics self-concept beliefs. Mrs. Watkins, Gabourey's mother, recounts that when Gabourey was in kindergarten, "she felt like she could not perform math. She felt like she couldn't perform a number of academic things." Mrs. Watkins attributes a "turning point" in Gabourey's mathematical confidence to the encouragement Gabourey received from her kindergarten teacher. Despite her encouraging progress, Gabourey would encounter further difficult periods during her elementary school years.

In her mathematics journal, Gabourey recalls, "In the second grade all the way up to 3rd grade, I have had a hard time in math. It was just always difficult for me." Mrs. Watkins remembers, "By the time we got to the second grade with her, she was literally in tears. … [She] didn't want to really do it. … To get her to recite her times table, it was like pulling teeth." She also reports, "I would go up to try to figure out what was going on because she was like, 'I'm sick. I don't feel good. I got a headache.'" Witnessing her child endure such agonizing experiences prompted Mrs. Watkins to apply to enroll Gabourey in an independent school. It is worth noting that during this period, according to her mother, Gabourey "had an A in math" a feat that Mrs. Watkins attributes to "the hand of God was just over her." Mrs. Watkins was grateful that Gabourey obtained a grade of "A" since "her mathematical ability was not good," and "she needed to have all A's to get into private school." Mrs. Watkins recollects that after Gabourey interviewed for private school placement in the second grade, "she went back to the class and spent some time with the kids. And … when she came out, she was like, 'Oh, I love this school! But I don't think I can do the math.'" Mrs. Watkins, indeed, confirms that when she was admitted into the independent school, Gabourey was "behind in math." Mrs. Watkins explains that—perhaps as a result of certain mathematics deficiencies—Gabourey "came into the third grade thinking she wasn't good in math, and that she would fail, or not do well in math."

According to her mother, the third grade year was significant in transforming Gabourey's mathematics self-concept. Mrs. Watkins points out that during that year at the independent school

> They didn't get grades, which was a huge boost. Because she didn't have to look at grades and say, "Oh, no. I'm not making the mark." So, even though she struggled with math in the third grade, that grade wasn't there to remind her that she wasn't making an "A", or a "B," or a "C."

Mainly for this reason, Mrs. Watkins reflects on this time as “the turning point for her to gain her confidence.”During the next few academic years, Gabourey would have alternating mathematical experiences of optimism and despair. She writes,

> In the 4th grade I started to get the concept on [sic] math. Something in my brain clicked and I started loving it. … But in the 5th grade, I started having the same problem I had before. … It got so much better in the 6th grade.

Despite the encouragement the school’s progressive cognitive and affective sensitive instruction during the fourth grade, in the fifth grade, Gabourey nevertheless withdrew from mathematics recalling: “I was failing and there was just a point where I gave up and felt like I couldn’t do it.” But after fifth grade, Gabourey found that she became more attracted to mathematics in the sixth grade. In her mathematics autobiography, she writes, “At first I thought I was horrible at math. But then in the 6th grade, I realized I was able to do it, and do well at it.” She adds[During] 2nd semester of my 6th grade year I realized [I] could do well in math. I didn’t understand my homework, so I asked my teacher if she could help me during recess. … I was amazed that I could do that. I was even more surprised when I saw how many people were there getting help it really made me feel better.

It is clear from her fourth through sixth grade experiences that Gabourey attaches a great deal of her mathematics self-concept to the sense of mathematics efficacy—that is, to her sense of being able to understand mathematical ideas and accomplish mathematical tasks.Gabourey connects her mathematics self-concept with her facility in comprehending mathematical concepts. She describes herself as

> A good math student, because I get it. And when I don't get it, I practice and then I still get it. So, I don't think I'm a great math student because, then, I would never get stuck. And I don't think I'm a bad math student, because I would never get the concepts. I'm a good math student because it's a little bit of both.

Her comment implies that Gabourey views wrestling with mathematical concepts as a struggle inherited by the less mathematically competent. By espousing this position, Gabourey could become vulnerable to undervaluing her persistence in mathematics and, consequently, become susceptible to undermining her construction of a more robust mathematics self-concept.Other self-descriptions that Gabourey offers suggest that her mathematics self-concept is dynamic and in transition. She more generally describes herself as "funny, smart, small, flexible, talented. Creative, and loving, caring." More specifically as a mathematics student, Gabourey characterizes herself as "intelligent, [and] patient" What is consistent in her global and mathematics-specific descriptions is that they both include "smart" and "intelligent" respectively. As she reflects on her capacity to learn mathematics, Gabourey assesses:

> It would take me some time to learn something new. It depends, actually on what it is. If it's a quick concept that's simple and easy, I would catch on more quickly. But if it's a little more abstract or a little more difficult in, like, the steps—or if there were … different possibilities to figure it out—then it would take me a little longer.

Although she views herself as "smart" and "intelligent," she acknowledges difficulties with mathematical abstraction and recognizes her need, in some instances, to take more time to contemplate and figure more difficult possibilities.Gabourey's parents express their concern for her general and mathematics confidence. Her father shares:

> Gabourey … needs to build her confidence. Her math teacher gives her a lot of encouragement, and says that she can do the work. I think when she hits on principles that she grasps easily, she does very well. But it's when she's challenged with some things that she had to repeatedly review things—that's when her confidence is shaken.

Her mother credits the Channel the Challenge summer enrichment program for helping to bolster Gabourey's confidence "because it's like they recognized that she had ability, allowed her to speak … at the end of that summer. Mrs. Watkins refers here to Gabourey being chosen as a student representative to speak at the program's closing ceremony. Also, Gabourey performed in a dramatization at a second Channel the Challenge closing ceremony during the following summer. From the experiences that her parents recollect, one could infer that Gabourey's general and mathematics confidence is buttressed by the support, encouragement, and recognition of significant others—including teachers, administrators, and peers.In addition to aspects of her confidence, Gabourey also expresses other affective components of her mathematics self-concept. Primary among these affective components are her level(s) of enjoyment of mathematics and the degree she looks forward to mathematics (and, in some instances, her mathematics class). When asked how much she enjoys mathematics, Gabourey responds that on a scale from one to ten, from least to greatest, "It would probably be a seven and a half, or an eight. Yeah, it would be an eight." This certainly marks a shift from the days when she considered mathematics her "downfall." She notes, "It's easier for me in my math class right now [in 7^{th} grade], 'cause I've already learned the stuff that we're redoing last year. So, it's the same right now." Her familiarity with the concepts facilitates her understanding. It is likely that she finds some fulfillment in a sense of accomplishment that might accompany her familiarity with mathematical content. This fulfillment from accomplishment possibly heightens her enjoyment of mathematics.

Gabourey also seems to find fulfillment in her capacity to understand mathematics and to perform well in it. She reports feeling better now about her experiences with mathematics than in previous years: "I just get it, I guess. 'Cause I just get it. It's not like the concept was any easier. But it clicked in my head." Perhaps the fact that she is now "getting it" and the mathematics is "clicking in her head" explains why Gabourey declares, "I like math now. And I'm doing well in it." She credits a great deal of her liking math *now* to her ability to figure out more problems. This marks a dramatic shift from two years ago, when Gabourey responded with a six (Very much like me) to the SDQ-II prompt "I hate mathematics." During the following year—that is, upon the most recent SDQ-II administration—Gabourey's response to this item changes from a 6 ("Very much like me") to a 4 ("More true than false"). She is careful to clarify, "Now, it's not that I don't like math. I mean, I like multiplying and dividing and stuff. But it's not like I want to be like a mathematician, when I grow up." Gabourey's increasing fondness of mathematics has, for her, its perceptible limits.

She also explains that her enjoyment of mathematics "depends on what lesson we're learning. … It depends of what type of lesson we're learning." Gabourey enjoys multiplication, division, and the distributive property, but admits an aversion to fractions: "Fractions confuse me a lot. But as of today, I'm getting better. … Right now, I'm pretty good at it, I hope." Gabourey's statement is both hopeful and speculative. This dichotomy is also observed in Gabourey's response to the idea of taking more advanced mathematics courses. Gabourey definitively insists that she would not take more advanced courses 'cause I don't think I'm there yet. I don't think I'm good enough yet." Memories of prior struggles with mathematics begin to assault Gabourey's self-concept beliefs and make her developing mathematical confidence more tentative. Through her comments, she reports a more optimistic, efficacious attitude, yet reveals a persistent struggle to overcome the doubtful apprehension that previously plagued her. Gabourey distinguishes that she tends to enjoy mathematics differently with different teachers "because they are more fun and can make learning math easy and fun." Gabourey implies that she does not particularly enjoy undergoing the rigors of difficult mathematical challenges. Instead, she prefers more social activities that are "fun" to her, including "group projects" and "math games."

Gabourey's preferences for social activity and for the fun she experiences in games are not surprising when one considers her parents' comments and reflections. Gabourey's father points out that she "is very, very, very social—makes friends easily." Also, earlier in Gabourey's childhood, some of her elementary teachers encouraged her mother "to play games with her." The familiarity with this pedagogical strategy also likely engenders her preference of game activities.

Despite her history of inconsistent mathematics enjoyment and variable mathematics performance, Gabourey fights to maintain lofty expectations of herself. During the fall 2012 semester of her seventh grade year, Gabourey evaluated that she did "pretty good. I got an A average." At this point, Gabourey affirms, "I expect A's. … And I try to get A's. And I expect—well I expect A's and B's. I'm okay with B's. Some people aren't, but I am." These expectations are heartening in light of Gabourey's previously alternating years of contempt for and delight in mathematics. She explains:

> Even though I might not have *enjoyed* math, you still have to do it. So, if you're the type of person who doesn't enjoy eating or something, you still have to do it to stay alive. So, it's the same with math. You still have to do it, because it's a part of every day.

Her comments highlight the importance she attaches to learning mathematics. For Gabourey, mathematics—however unpleasant some of its experiences come to be—is a necessary, yet unavoidable, reality. Gabourey chooses to attempt and to expect to do well. These choices and expectations suggest that her mathematics self-concept is developing in its strength and point to an encouraging possible future.

Constructing Competence

Gabourey's mathematics competence and self-concept belief reflect the influence of her teachers, family, and peers. The influence of teachers figures prominently in Gabourey's discussions of her mathematics self-beliefs. She credits them with the power to engage affective shifts in student attitudes about mathematics through clarifying concepts, differentiating instruction, and through demonstrating (other) acts of care. Interactions at home with her family provide Gabourey with academic encouragement within a framework of expectations already established by her parents and—perhaps to a lesser degree—her siblings. Gabourey is able to weave aspects of these expectations into her own for her achievement and progress of competence in mathematics. She also positions her abilities relative to her older siblings, especially to her brothers who have generally excelled in mathematics. Gabourey also extends these comparisons to her peers at school positioning others—and self—within interactions with classmates with whom she sometimes collaborates to complete mathematical assignments and tasks.

Gabourey's interactions with teachers, family, and peers shed light on how she identifies herself as a person and which aspects of her self become salient as a mathematics student. The ways Gabourey describes herself reveal associations she potentially makes regarding gender, her identity, and her mathematics self-concept. Also in her discussion and self-descriptions, Gabourey asserts a self-conceptualization as a student motivated to achieve competence and success in mathematics. Through expressing her beliefs about competence in mathematics, Gabourey reveals not only her views about mathematics, but she also reveals the ways she positions mathematics and, consequently, how she sees and positions herself in relation to it.

Teacher Interactions. Gabourey's attaches an essential role to teachers in the formation of students' self-beliefs about mathematics. She argues, "It's very important, because the teacher is supposed to be the one who is teaching you the math concept. [The role of the teacher] … is very important because I have to get it the first time. But if I don't, the teacher has to be willing to help me through it." Gabourey's statements reveal her fundamental expectation of teachers to *teach*. At the same time, though, she recognizes her responsibility as a student to "try to get it the first time." Gabourey's emphasis on understanding concepts the first time possibly reifies her notion that mathematics readily understood readily evinces and affirms mathematical competence. Her final statement also points to a particular disposition of being ready and available to assist students. In her description of her interactions with teachers, Gabourey not only highlights specific dispositions, but she also emphasizes certain educator personality traits and pedagogical approaches. The dispositions that teachers adopt and display, the characteristics they assume and demonstrate, and the pedagogical approaches they embrace and implement significantly determine the degree these educators are able to assist students' construction of robust mathematics self-concepts.

Gabourey attributes to her teachers great power in influencing her attitudes about mathematics. When prompted to elaborate further on her statement "I like math *now* and I'm doing well in it," she replied, "It always depends on the teacher who teaches you the material. So, she changed my thoughts."

The centrality of the teacher is apparent as Gabourey evaluates her affective shift. In addition, Gabourey's mother asserts that student interactions with teachers are instrumental in establishing and developing student confidence in mathematics. Mrs. Watkins attributes Gabourey's blossoming confidence during her early school years largely to the "great encouragement [she received] from her kindergarten teacher." Mrs. Watkins also maintains, "She's at least confident now that, depending on the teacher, … she can be successful in math."

Gabourey's parents insist on the importance of educators' attempts to differentiate their teaching strategies in order to accommodate the learning preferences of the students they teach. Her father states:

> We've learned somewhere through the years with all the children, there are different techniques of learning styles. And I really believe once that learning style matches—or lines up with— the content of the math, I think Gabourey will really tremendously grow in leaps and bounds.

Mrs. Watkins further explains that "if a teacher has only one way of teaching, then it makes it difficult for a child if that's not that child's learning style." Gabourey has specific ideas about the pedagogical strategies that promote more efficacious behavior for her. For example, with regard to an effective teacher, Gabourey stated:She would help me understand better. She would go over it, if we had questions. And if you didn't have questions, to start working on problems … for homework. Or if we were going over a quiz, do some practice problems. And she would take as much time as we need to answer questions that we had.

Clearly, Gabourey prioritizes understanding and elevates teachers' efforts to facilitate student comprehension. It is also essential to Gabourey that her teachers are not only willing to answer questions but that they also take "as much time as needed" to do so. This is particularly significant for Gabourey in that she is aware of her history of difficulty with mathematics and understands herself to be a student who may need more time to complete some mathematical tasks and exercises.According to Gabourey, her teachers' dispositions and personalities contribute to her self-concept constructions. In describing one of her favorite teachers, Gabourey points out that "she's fun, she's nice, and she's patient for some of us who don't get the concept as soon as others." She adds that this teacher and the seventh grade teacher she presently enjoys "both really care about teaching us something. So, they would both take time to answer questions." In favorably discussing other teachers, Gabourey would mention that they were "fun," and "nice."

She also repeats her appreciation of teachers who are personable, accessible, and supportive. Gabourey offers the following description of her fourth grade teacher:

> She's really nice in general. … So, she's really nice to me and everybody. … Just the way she talked, the way she explained stuff to us, and the way she supported us. Like she would help us with math problems. She would help us with *any* problems. … She could be your teacher *and* she can be someone you could talk to.

Gabourey highlights again that explaining and assisting are the kinds of interpersonal dynamics under which her self-beliefs thrive.Gabourey contrasts interactions with her fifth- and sixth-grade teachers. She also characterizes drastically different consequences/responses to these interactions. Gabourey states that her fifth grade teacher "was just tough. She was nice when it came to like just seeing her in the hallway or talking to her out of math class. But she was very hard and strict in math classes." Both her parents (in two separate interviews) used the word "rigid" to describe this teacher. Mr. Watkins opined, "[She] was cut from a different piece of cloth … to be teaching younger children." Mrs. Watkins reports that the fifth-grade teacher would telephone her saying "I think she [Gabourey] can do better. She's not really focusing." Mrs. Watkins regrets this periods when she witnessed Gabourey "starting to slide back into that 'Oh, I can't do math' [mindset]." Gabourey writes in her mathematics autobiography, "I was failing and there was just a point where I gave up and felt like I couldn't do it. What caused that was my teacher." Gabourey attributes her withdrawal from mathematics, and from this mathematics class, exclusively to the teacher.

Conversely, Gabourey credits her recent sixth-grade and present seventh-grade interactions with teachers for shifting her mathematics self-concept more positively. She remembers her teacher in sixth grade "explaining," "helping," and offering "morning and recess help." Gabourey recollects, "At first I thought I was horrible at math. But then in 6th grade, I realised [sic] I was able to do it, and do it well. My mom and teachers helped me realize it too." Gabourey attributes the transformation of her mathematics self-concept to the realization fostered by her own collaborative efforts in concert with those of her mother and teachers.

Gabourey's self-ideas seem responsive teachers' dispositions and personal interpersonal traits. Yet, her self-beliefs are also appreciably sensitive to (her perception of) teachers' attitude towards her. In other words, in addition to its connection to the degree of complementarity of her teachers' and her personality traits, a portion of Gabourey's mathematics self-concept is attached to the way she *feels* her teachers feel about her. Gabourey's mother recalls her last elementary school teacher:

> She just connected with Gabourey. Gabourey is very expressive and creative. And the sixth grade math teacher was very creative. … Even though math has sets of rules, she made it fun. She just didn't, "*I-before-e-except-after-c-and-that's-it*" kind of thing. So, that's the thing that really works for Gabourey—creativity.

According to Mrs. Watkins, one of the reasons Gabourey's academic esteem flourished during the fourth grade was that "she didn't come in worried about whether or not the teacher was gonna like her, or whether the teacher was hard." Gabourey had been acquainted with this teacher in her previous academic year when the teacher was an aide/assistant.Gabourey finds motivation in her current seventh grade teacher's caring disposition:

> I think my teacher would probably want me to do well in math because … she goes deeper into just math. Like, she's not just a math teacher. She loves us. And so, she wants us to do well in math, not because she wants … to brag about it to her other math teachers. She wants us to pass because she thinks that we can do well in math. And she knows we can do it.

Gabourey confides that this teacher is also her cheerleading coach. So, she shares with her a relationship that extends beyond that mathematics classroom and likely provides interactions of both comfort and challenge. Gabourey's belief in her teacher's confidence in her and her classmates' ability, along with her teacher's interest in and commitment to their progress, could effectively help Gabourey to address what her mother describes as "overcoming the fear that she couldn't do it." Liberation from such fear strengthens Gabourey's resolve and, in turn, fortifies her mathematics self-concept.*Family Interactions.* In addition to the considerable influence of interactions with teachers, conversations with Gabourey and her family reveal that her interactions at home also significantly contribute to the construction of her mathematics self-beliefs. Conversations with Gabourey and her parents provide evidence of her parents' attempts to provide a structured environment for the pursuit of academic rigor, achievement, and persistence. Although Gabourey's parents make clear to their children the high expectations they hold for them, they also provide an environment of support and encouragement so that they will embrace and achieve these goals. As she inherits the expectations and exhortations of her parents, Gabourey uses these—along with her individual experiences and responses to them—to help fashion her sense of her mathematical self.

Remarkable, each child in Gabourey's family attends a different (type of) school in a different district. In doing so, Gabourey's parents establish that their home is one of high academic expectations standards, yet flexible in the manner in which each child's academic needs are met. Gabourey's oldest brother took Advanced Placement (AP) courses in physics and calculus, before pursuing a college degree in engineering. Gabourey's other brother was identified as "gifted" in kindergarten and presently takes courses in physics and geometry at an independent school. Her older sister is, in her father's estimation, a "gifted writer." Gabourey's mother, Mrs. Watkins, reflects:

> When they first started in elementary I was like, "Okay, what's the best school in this area?" And it was the *theme schools* at the time. … I tried to get everybody labeled as "gifted," because I always try to get whatever's at the top. It's like, "Let's shoot for it, and see where we fall."

Gabourey's parents clearly establish a home that fosters a climate of striving for the highest levels of accomplishment.Embedded within her parents' implicit expectations are also implicitly understood acceptable levels of academics performance. Gabourey declares that her parents "expect me to do well. … So, I think they expect—because they know I can do it. They know I have it in me to do the math. And that works for me." She reveals more explicit expectations: "They expect me to get A's. And as long as I give it 100%, they're okay with me getting other grades. But as long as I give 100%." Although certain grades are preferable—and required for particular school and district accelerated/ advanced programs—Mrs. Watkins makes it clear that her children "still [have] to pass Mommy."

Mrs. Watkins clarifies that the standards of their household were typically undeterred by frustration or sympathy. For example, she tells the story of helping Gabourey learn and remember multiplication facts:

> I had all the time[s] tables, and I would make her do them over and over. She would be in tears, and I'm like, "No, you gotta get it. I don't care if you don't like it. You still have to get it." And she would get this glazed look in her eye. She would just kind of like look at me like, "[Discipline] me if you will, but I'm gone."

Two conflicting forces simultaneously converge in this tense impasse. There is the determination of an insistent parent determined to push (or to help her child push) through a moment of academic challenge. The force of this determination is juxtaposed with a child's conviction of her self-beliefs of mathematical incompetence. Consequently, Gabourey's convictions regarding her presumed incompetence occasionally render her incapacitated as she endures assaults to her self-concept.Gabourey finds some asylum from the conflict in the support of her parents. One of the ways that they demonstrate their support to Gabourey is through offering, and finding, practical assistance in mathematics. Mrs. Watkins admits that she did "the same kinds of things with each kid." The teaching and tutoring strategies include the use of manipulatives and supplemental textbooks. Gabourey's father points out, "We would try to reinforce things at home and try to get her siblings to help her at home. We would get special aids, Internet, and flash cards, and things like that. And that would help." Mr. Watkins says that when their collaborative attempts do not produce the anticipated result of academic growth, they enlist additional strategies to investigate the source of Gabourey's impasse:

> We try to identify what happened—where were the shortcomings, the shortfalls. And if we see it's more behavior-oriented ("Oh, I didn't study for these tests" or "I didn't do my homework") or this or that, then we really enforce or stress the importance of performing well when you have the ability to perform well. If it's matters of "I didn't grasp the concepts," then

> we're more understanding, we're more encouraging: "Go to your after-school tutoring. Speak with your friends in school that have strengths in that area. Ask questions. Ask questions. Ask questions," we stress to her.

Gabourey's parents' actions and statements suggest that they have an implicit belief in her "ability to perform well," and interpret less productive attempts as unacceptable. Gabourey confirms understanding their support as encouragement, "They really want me to do well in math. They're very encouraging, I guess. They just really want me to do well." As a matter of fact, Gabourey writes in her autobiography that in the sixth grade she came to realize that "I was able to do it, and do well at it." She further explains, "My mom and teachers helped me realize it." Although Gabourey assumes the bulk of the responsibility for this epiphany, she credits the collaborative efforts of her mother and teachers in supporting her understanding of her mathematical competence.Gabourey's parents assume instrumental roles in encouraging and bolstering her confidence in mathematics. Her mother reflects:

> I mean, we spent a lot of time trying to boost her self-confidence in her ability to [do] math. And then the fact that her brothers are just like *brilliant* in math. So, she's always kind of like lived in that shadow of unsurety [sic].

Mrs. Watkins contrasts Gabourey's struggles with mathematics and mathematics confidence with her sons' mathematical prowess and promise. Mrs. Watkins presumes that by helping Gabourey to boost her confidence, that she could escape the shadow cast by the uncertainty of her delicate mathematical self-concept. Her father affirms their roles as parents:Obviously, the parents are … the number one motivators. Parents have to encourage their children, have to also hold their children accountable for their grades and their school performance—have to be the disciplinarians, have to also be the great cheerleaders for the children. It's an overall balance of all these roles, I believe.

Mr. Watkins makes it clear that the support and encouragement his family enjoys is not without accountability and discipline. Yet, he asserts his responsibility as a parent to cheer his family members on and motivate them to strong academic self-beliefs.*Peer Influences*. Gaboureys' father indicates that she is "very, very, very social [and] makes friends easily." Gabourey confirms this characterization in her social knowledge structures, the graphical representation of her self-descriptions. She uses words such as "friend" (and "friendly"), and sensitive during her first representation (Appendix J3). A year later, she repeats her use of "friend," and includes "nice," "genial," and "kind" as descriptors. Her second SKS (Appendix J4) reveals that she considers herself as a "learner" and a "leader." Her choice of words and the increasing proportion of interpersonal terms suggest that Gabourey places great emphasis on social interactions.

Gabourey's parents express concern about the how her social personality could threaten her academic focus, performance, and confidence. Her mother feels that "especially children … like Gabourey who aren't confident in who they are" are vulnerable to the influence of peers on what children believe about themselves as students. In her statement, Mrs. Watkins does not limit her concern to Gabourey's confidence in mathematics, but extends it more broadly to confidence in who she is. Mrs. Watkins is concerned with Gabourey's formative self-concept and its susceptibility to peer influences.

Gabourey's mother is particularly mindful of the potential effects of strong, self-confident, efficacious students on more mathematically insecure students like Gabourey:

> They can tend to go into like a meltdown, or go into a shell because there are bright, shining stars or children who fake it til they make it. And actually, in Gabourey's fifth grade class, she had one of those bright shining stars in her class that had an opinion – that was very confident of who she was and is. And because she attended a school that was majority White, this particular young lady was African American as well. And so, she was just like, over the top. Very, very courageous, very focused, very outspoken. And so that kind of made Gabourey kind of go back into the shell 'cause she would like, raise her hand, then she would lose her thought.

According to Mrs. Watkins, in the presence of a "bright shining star" in her classroom, Gabourey insecurities about mathematics were amplified. Consequently, Gabourey was not able to fully concentrate or participate. Mrs. Watkins also recountsWhen she was concentrating on trying to focus, this young lady was kind of like … [one of Gabourey's brothers], and would just know some stuff, and start doing other things, so Gabourey was intimidated by her brilliance, so she wasn't able to be a shining star herself.

Mrs. Watkins's recollection's illustrate that Gabourey is sensitive to the abilities of her classmates and (self-)conscious of her relative position along the spectra of competence and confidence.Gabourey's fifth grade experience of being "intimidated by the brilliance" of her classmate and her description of the advantages and disadvantages of being “smart” contain elements worth noting. For example, in her first social knowledge structure graphic, Gabourey uses the word “smart” to describe herself and she ascribes a positive valence to the term. However, when asked what she thought others thought about possessing the quality, presumed that many people would assign negative value to being “smart.” She explains the distinction in the following manner:

> I think “smart” is good because it can get you far. It can get you a good job and people could respect you more. And some people might think smart is a bad thing because … they could be intimidated by smart people and … nobody would understand what you’re saying. They won’t understand what you’re saying ’cause you might be too smart for them.

This is relevant in that Gabourey relates that intimidation brought on by interactions with the “brilliant,” or “smart” could arise from the lack of understanding present in encounters with *more brilliant* or *smarter* others them. Her mother’s recounting of Gabourey’s fifth grade experience highlights the consequence of Gabourey losing her thought in the midst of being intimidated by the other student’s brilliance.Despite the temptation to feel overwhelmed or overshadowed in the midst of more capable others, Gabourey maintains that she is willing to approach others for assistance:

> If I’m having troubles with math at school, I would ask … my friend who sits next to me. And if I have trouble at home with my math homework, I would ask my siblings and then my parents and then my friends over the phone.

At home, Gabourey has a sister, who is a high school junior, and a brother, who is a high school freshman. But it is her brothers’ mathematical acumen that she admires most explicity. These are the brothers (one in college) whom Mrs. Watkins describes as "brilliant in math." Gabourey confirms, "They're really good at math and … I want to be as smart as them and like my friends, my family, my teacher." Gabourey lists here not only those whose ability she admires and respects, but also those whose interpersonal connections she values and trusts enough to enlist their assistance.Gabourey appears to have constructed her sense of her mathematical self using her evaluations of the relative competence of those around her. One way that she does this is by assessing the degree they need or seek help compared to her own needs and requests for assistance. For instance, Mrs. Watkins remembers Gabourey's third grade at a new school:

> They had a teacher, and an assistant, and I think the classroom size was maybe 15. So, the assistant would help her a lot, and pull her aside, and she wasn't the only one. So I think that made her feel better, even though she was the only—maybe only—new kid in that class. It made her feel better that she wasn't the only student getting help.

Gabourey also reports that during the second semester of her sixth grade year, when she realized that she "could do well in math":I didn't understand my homework so I asked my teacher if she could help me during recess. She said "Sure," and she also told me that I could [come] a little bit earlier in the morning. And I was amazed that I could do that. I was even more surprised [sic] when I saw how many people were there getting help, it really made me feel better.

These episodes suggest that the negative feelings that Gabourey could be tempted to feel about her need for help, the implications that need makes about her ability, and the consequential threats to her mathematics self-concept could buoyed by her understanding of herself as one among several students who need, pursue, and receive assistance.*Identification, Identity, and Positioning.* In her graphical social knowledge structures, in both of two administrations a year apart, Gabourey includes identical gendered references to herself as a "sister," and as "pretty". In the first SKS administration (Appendix J3), she also associates words such "creative," "flexable" [sic], "sensitive," and "dauhter" [sic] with the female icon. In the second SKS administration (Appendix J4), Gabourey acknowledges her roles as a "neice" and "babysitter." She also describes herself as "kind," "genial," and "nice." Gabourey connects all of these descriptors to the female icon. It is interesting to note that Gabourey also describes herself, in the second SKS, as "bold," and "brave," characteristics that she feels (and believes other people feel) are more masculine traits. She uses the word "leader" to describe herself. Although she indicates that she believes other people feel that it is more masculine, she does not suggest her own gender ascription of this term. Gabourey's self-descriptions help clarify the ways she identifies as an individual. These descriptions suggest what aspects of her self are salient at different times. They also, to some degree, indicate the gender associations that Gabourey has developed and is developing.

As Gabourey's responses to items on the *Mathematics as a Male Domain* subscale of the Fennema-Sherman Mathematics Attitudes Scales (1976), also communicate some of her attitudes about gender perceptions and mathematics (Appendix P). She asserts the following about the relative mathematics aptitudes of males and females:

> I think we're the same. Some people may be, but it doesn't matter. I think there's an equal amount of people in the world that are smart. I guess. … Like boys aren't naturally better than girls and girls aren't naturally better than guys. It just depends on the person.

It is worth noting that in her first SKS, Gabourey describes herself as "smart." Her statement makes it clear that she is as eligible as any other female, or any male, to be characterized as such. Another item on the *Mathematics as a Male Domain* subscale asked for a response to the statement "Girls who enjoy studying math are a bit peculiar." Gabourey affirms, "I totally disagree with that and then, girls can't just be titled as 'peculiar' just because they like to do math." Although it is unlikely that Gabourey identifies herself as enjoying studying mathematics, she resents the characterization of a girl who does as unusual or exceptional.Gabourey also offers less explicit suggestions regarding her possible gender associations. For example, Mrs. Watkins, Gabourey's mother has accounting degree and describes herself as "a numbers kind of girl." Mr. Watkins describes Gabourey's sister as follows:

> Our 16-year-old daughter takes math with a grain of salt. Her preferences are more for language arts, poetry. She is a gifted writer. Math classes she can take or leave. It does require some effort on her part to achieve a B or an A in the class.

The description of this sibling is comparable to a characterization of Gabourey. Despite the possibility that Gabourey may identify in a number of ways with these female family members, she hardly references either her mother or her sister explicitly in our conversations about mathematics competence. Instead, her *brothers* are "brilliant" and "smart" in mathematics. Also, Mrs. Watkins points out that her children may be able to distinguish differences in her educational experiences and outcomes, and her husband's: "They can clearly see the difference because he remembers all of that stuff, all the theorems, and … he had a better educational experience than me." Although Gabourey's exclusion of her mother and sister in her discussion of mathematics competence is insufficient evidence to make assumptions about her ascriptions of mathematical competence as a male domain, the strength of her brothers' mathematics acumen—and her and her family's celebration of it—may tacitly endorse such a gendered association. Her family's encouragement of achievement in all disciplines—including the language arts, which she and her sister seem to prefer—may help to interrupt such correlations.When the subject of race entered the discussion with Gabourey, she revealed an almost colorblind ideology—one tinged with egalitarian sensibilities. When asked to comment on being a Black female at her school, she appears confounded and begins to bristle with slight discomfort at the indelicacy of the question. Then, she offers this response:

> I don't know. It's just – it doesn't matter, so it's like saying how is it, like being like brown-eyed at a school full of blue-eyed people. I mean it doesn't matter what color. Everybody's different. Each [has] their own mind and their own thought process. So, it's just one blended in—like *all* the students.

In a sense, one could say that Gabourey's sentiments reflect that kind of optimistic ideal to which America strives—an ideal in which skin color does not matter. However, one could also ask "*For whom* does it not matter?" *To whom* does it not matter?One of the links to the website for the school Gabourey attends prominently features information about the institution and photos of individuals in the school community, including students, teachers, administrators, coaches, and parents. The website highlights many of the school accomplishments and is undoubtedly a strategic marketing strategy. I happened to come across a photograph of the seventh and eighth grade chorus. The link praised the organization for earning a superior rating in a performance evaluation. The group was consisted of an adult who most like served as the advisor/sponsor, who was flanked on the left by five girls and on the right by seven other girls. In front of the club sponsor, who stood in an arc with these students, sat two other girls back-to-back with their hand crossed over their bended knees. The girls who stood with the sponsor couched a bit over the students on the floor. The students looked as if they were related. They all wore the same uniform: a plaid skirt just above the knees, a dark vest over a white shirt, dark socks over the calf, and light colored leather shoes. They each had long blonde or brown hair that hung below their shoulders. One girl seemed different though. This student was Gabourey. Her position seemed intentional and highlighted. She stood between the teacher and the two girls sitting in front of her on the floor. Gabourey leaned forward to form the apex of a triangle of singers and smiled in unison with her choral comrades in celebration of their honor. Her interlaced fingers formed a cradle for her bespectacled face. But what would Gabourey be able to see with her brown eyes? Would her conspicuous positioning escape her insight? If issues of race and skin color do not matter to Gabourey, do they matter to her classmates? Her teachers?

Her legislators? These matters of race and skin color become increasingly significant when conceptions of competence are attached to such conversations.

Gabourey restates her beliefs in the irrelevance of racial difference as she reflects on the state of African American mathematics learning potential:

> I think they have the potential doing good just as any other race. I mean it doesn't matter. It's just like a color. You can bleach it, if you want. … It just doesn't matter. It just matters … how fast they get it and if they don't get it, ask quickly. Like how much willpower they have to push themselves to learn it and practice it. So, I think as a group of Black people, I think they can do just as well as anybody else.

Gabourey expresses concerns about the cognitive and motivational aspects of learning. Although Gabourey revisits her association of competence with speed, she emphasizes here the importance taking initiative to ask questions, and having willpower to learn and persevere.Gabourey asserts her own identity as a motivated student. She offers herself as example who demonstrates the necessity "to push yourself even though you think you might not be good at math. Or if you're good at math, you need to push yourself and maybe like have a goal." She attributes the success she experienced during what is her first year of middle school to her motivation to persevere and achieve:

> I just wanted to push myself. I guess [it] was just like me pushing myself, because I wanted to get a good average in all my classes last semester because I wanted to do well in my first year. So I think it's just me pushing myself.

Motivation, especially in the face of challenge, becomes an integral component in Gabourey's conceptualizations of mathematical competence and her mathematics self-concept.The social aspects of Gabourey's character prompt her to broaden her scope of friends, incorporating a variety of individuals from diverse backgrounds: "I had some Black friends. ... I just didn't hang out with just them. I hung out with other people as well. But they helped me like start off the year with some friends. And then, like, I branched off." Gabourey distinguishes the African Americans with whom she interacts by their motivation:

> The Black people that I know push themselves. And if they don't, maybe if I'm like close friends with them, I push for them—like a little start off. But I guess in general—I'm not really sure—but maybe they don't push themselves hard enough. Because you don't see – well now you do—but you used to not see a lot of Black people in a lot of like high stuff, like important stuff like the President or something. But now you see President Obama and he's the President. But he's Black.

Gabourey's reflection reveals that she observes differences in racial achievements. Despite the fact that she recognizes differences, Gabourey does not yet (outwardly) interrogate the reasons for these. She acknowledges differences in the significance ("importance") attached to these achievements and in the striving to accomplish them. It is, perhaps, her understanding of herself as a "leader" and "friend" that allows her to encourage ("push for") others and herself to aspire to and achieve such ambitious accomplishments. This understanding, though, presupposes a self-concept of strength and advantage (of position).Gabourey's makes an affective shift in her attitude towards mathematics courses. She comments in our first interview, "Math isn't the worst subject that I have. But it's also not the best. It's just in the middle." She places language arts as "best" and history as "worst." In the third interview, Gabourey points out that among all of her seventh grade classes, "I like math. So, It's certainly not going to be in the bottom of the seven. Probably like number four. No, probably number three, actually." She clarifies that math and French could possibly tie for third. Although it is not clear from these statements alone whether Gabourey's affective shift is an increasing enjoyment of mathematics, mathematics class, or both, she assert that it is "very important for me to be good in math." Her emphasis on its importance, though, positions mathematics as an area in which competence is highly valuable.

Another type of positioning evident in conversations with Gabourey is the positioning of the peers around her. This is apparent as she mentions seeking help "if I'm having troubles in math … [from] my friend who sits next to me" and "friends over the phone." In addition to her mathematically-inclined brothers, Gabourey admits, " I want to be as smart as … my friends, my family, [and] my teacher." Gabourey's fondness and admiration of the acumen of these individuals helps position them as *mathematically competent.* Her valuation of mathematics learning and knowledge, coupled with these friends' relative strength in these areas positions these individuals as exemplars of ability worthy of imitation.

Gabourey also engages in the positioning of family members. She has two older brothers: a high school freshmen enrolled in an accelerated Geometry class at a different independent school; and a college freshman who scored a 5 on the Advanced Placement (AP) Calculus examination and is completing a Calculus II course. Gabourey describes her brothers as

> They are very smart, very smart—*especially* in math. I guess they just get it quickly. And it sticks and they absorb it and learn it. And then – so if I have a question, since they're older than me, they have the same problems like the ones I would have trouble

> with. So, they would help me with them. And I think – I know my oldest brother likes math. I'm not sure about my other brother—my other older brother—but he's still good at it.

Gabourey does not only engage in positioning members of her family; she also undergoes positioning *by* her family. Some of this positioning is through discursively situating the abilities of siblings. Gabourey's mother acknowledges "the fact that [Gabourey's] brothers are just like *brilliant* in math." Mr. Watkins summarily describes Gabourey's brothers and sisters as follows:I believe Devante, who is a freshman in college, has a strong like for math. He is taking calculus, I believe now, as a freshman, and since junior high school, it seems, he has just really excelled in his math courses, and he enjoys math. Our 16-year-old daughter, who is a junior in high school, she takes math with a grain of salt. Her preferences are more for the language arts, poetry. She's a gifted writer. Math classes she can take or leave. It does require some effort on her part to achieve a B or an A in the classes. Gabriel, our son who is a freshman in high school, does well in math, and pretty much across the board. He's an A/B student, and with effort, we believe he can easily be a straight A student. We have him in an honors math course. And it is really, really challenging him. He's having to work hard, but he is able to maintain a low B level.

Although Gabourey is not directly referenced in this family synopsis, the fact that they direct her to "ask her siblings" for help ascribes to them a proficiency that enables them to assist their younger, less capable sister. It also positions Gabourey as a person—perhaps *the* person—in the household most in need of mathematical assistance.Gabourey's parents support her placement in her school's pre-algebra class, which emphasizes topics in algebra and geometry while reinforcing arithmetic concepts and procedures. Mrs. Watkins points out that during fifth and sixth grades, students were in the same mathematics class. For seventh grade, though, they have the Honors, or the algebra. … And then they have pre-algebra. And I think that was the perfect fit for her." Her class meets three days each week on a block schedule. Mrs. Watkins feels that Gabourey's placement in this level mathematics class is appropriate. This placement is a positioning of sorts of Gabourey's mathematical competence and, perhaps, the promise it portends.

Starting to Click

As Gabourey completes her seventh grade academic year and her first year of middle school, her adolescence continues to be in development. As this adolescence introduces physical, cognitive, and psychosocial changes, so too do her ideas about her self and others (in relation to her self) undergo transformations. Gabourey's mathematics self-concept reflects some of these developmental shifts. Unlike other periods when she considered mathematics as a "downfall," Gabourey acknowledges that her enjoyment of mathematics is growing. Gabourey's recent performance in mathematics is also indicative of her positive shifts in affective components of her mathematics self-concept, such as enjoyment and motivation.

Gabourey indicates that she feels better about her more recent experience in mathematics. Her Self-Description Questionnaire II (SDQ-II) response to the prompt *I've done well in mathematics* changes from a 1 ("Not like me at all") in 2011 to a 3 ("More false than true") in 2012. When asked about her seventh grade mathematics achievement, Gabourey reports that she did "pretty good. I got an A average." Gabourey attributes some of this accomplishment to her teacher who "would help us understand." Gabourey values understanding and appreciates being familiar with the content. This familiarity, Gabourey believes, helps to foster her comprehension.

More compelling is the direction of Gabourey's shift in her attribution of her recent mathematical achievement success. Although, at first Gabourey does not fully identify the source of her success, she specifies—to some degree—its location: "I just get it, I guess, 'cause I just get it. It's not like the concept was any easier, but it clicked in my head." When pushed to consider why things seemed to "click" more for her this academic year, Gabourey answers:

> I don't know. I guess I just wanted to push myself. I guess I was just like … pushing myself, because I wanted to get a good average in all my classes last semester, because I wanted to do well in my first year. So, I think it's just me pushing myself.

Gabourey does not diminish her accomplishment by minimizing its difficulty. Instead, she acknowledges that things began to happen "in my head." Without naming it as such, she realizes her own cognitive development. But perhaps more significantly, she also assumes more responsibility for her motivation and its consequences. She is both the agent and recipient of her actions ("me pushing myself"). Consequently, she becomes the benefactor and the beneficiary of her own encouragement. Motivated by her desire to achieve, Gabourey pushes herself—even through difficulty—to persevere. The fruits of her motivation and persistence include a more receptive conceptualization of mathematics as accessible, comprehensible—even possibly enjoyable—and a more fortified concept of her mathematical self as agentic, diligent, and competent.

DISCUSSION OF FINDINGS

Chapter Ten:
CROSS-CASE ANALYSIS

This dissertation used semi-structured interviews with a subset of students and their parents to investigate what constructions of mathematics competence these African American students have and the ways they arrive at these conceptualizations. First, this study interpreted data from interviews, student mathematical autobiographies, and mathematics logs to explore participants' mathematics competence beliefs. Second, in order to investigate students' mathematics self-concept beliefs, I complement interview data by utilizing various instruments. Social knowledge structure graphics have been analyzed to glean information on participant dispositions and self-ideas. The Self-Description Questionnaire II (SDQ-II) was administered on two occasions a year apart to examine the ways students described themselves and the stability in their self-descriptions. Their mathematics self-concept beliefs were also investigated by examining participant responses to the *Attitudes Towards Success in Mathematics* subscale of the Fennema-Sherman Mathematics Attitudes Scales.

Third, in order to investigate the manners in which students come to construct their mathematics competence and self-concept beliefs, I attended to their interactions with the significant others that students named in our conversations—interactions with teachers, family, and peers. I examined participants' responses to the *Mathematics as a Male Domain* subscale and the *Multidimensional Inventory of Black Identity-Teen* to provide insight into the multiple ways that participants construct the mathematics self-belief. These instruments illuminate the individual, school, and community forces that Martin (2000) emphasizes in his framework for analyzing the mathematics identity and socialization of African American students. At the same time, though, these instruments also explore the extent of the influence of sociohistorical forces on participants' mathematics self-conceptualizations.

In the previous six chapters, I have examined each of my three research questions at the level of the six individuals participating in my study. Each of these six cases can be read and stand alone as findings related to these research questions. In this final chapter, I will now reexamine my research questions across the six cases using the theoretical frameworks introduced in chapters one and two. I will conclude with my suggestions for some of the implications of my findings for parents, teachers, policy makers, and educational researchers.

Research Question One

What mathematical competence beliefs are held by a sample of adolescent African American students?

As participants shared their beliefs about what comprises competence in mathematics, these stated beliefs can now be compared with the notions of competence held by leading scholars in the field of mathematic education. Skemp describes instrumental understanding as following "rules without reasons" (p. 20).

He defines relational understanding, on the other hand, as “knowing both what to do and why” (p. 20). Kilpatrick et al choose *mathematical proficiency* to capture what they “believe is necessary for anyone to learn mathematics successfully. They maintain that mathematical proficiency weaves together five components referred to as strands. These strands include conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. In the study participants’ descriptions and conceptualization of mathematics competence, it is interesting to note how often they embrace elements of Skemp’s notion of relational understanding and Kilpatrick et al’s concept of mathematical proficiency.

Participants in the study repeatedly report that the capacity to solve problems—arguably a process that requires effective use of all five strands in Kilpatrick et al’s depiction of mathematical proficiency—and the need to understand procedures and concepts are central to these students’ beliefs about mathematical competence. This general finding indicates a mathematical sophistication that belies their age and place along the continuum of the mathematics curriculum. A cursory review of participants’ mathematics competence beliefs may (mis)lead one to assume that they support an orientation solely toward instrumental understanding as the most vital competence component. But this is quickly belied by the unanimity of participants identifying the ability to solve problems as a key element of mathematics competence. This is not surprising given that half of the students defined mathematics by invoking its applications in problem solving. Tamar describes mathematics as "an accurate way of solving an answer." Tyson echoes her perception, offering that mathematics is "mostly solving problems." Aminah and Bryan state that mathematics is most useful to "figure out … a problem" or "come up with a solution," respectively. Gabourey and Omari are slightly less explicit in their naming solving problems as an essential mathematics competence component. Gabourey implies the ability is essential through her endorsement of practicing problems to develop and augment competence. With his excited support of the problem solving activities in *Math Seminar* at his Montessori school, Omari also suggests the centrality that solving problems holds in his notion of mathematical competence.

With regard to Skemp, although initial inspection of their competence descriptions may seem to suggest an instrumental understanding orientation, when one considers their emphasis on comprehending concepts, procedures, and processes, participants' descriptions of mathematics competence grow broader to embrace more relational understanding. This broadening description of competence also aligns with the various strands of mathematical proficiency. Procedural fluency is "skill in carrying out procedures flexibly, accurately, efficiently, and appropriately" (116). Conceptual understanding is the "comprehension of mathematical concepts, operations, and relations" (p. 116). Each participant highlights abilities to understand mathematics concepts and using them to solve problems. They place in the foreground comprehension of mathematical concepts and, as Omari advocates, understanding of mathematical principles and processes. Although Omari focuses more on these processes, Bryan encourages grasping “a firm idea of the problem at hand.” His twin, Tyson, stresses the importance of knowing how to find ways to figure out mathematical concepts and principles. This type of knowledge aligns with Kilpatrick, Swafford, and Findell’s concept of strategic competence, “the ability to formulate, represent, and solve mathematical problems” (p. 16). Bryan alludes to this competence component as a kind of readiness to “think on their feet.” He stresses not so much speed as a capacity to formulate strategies to address problematic situations.

Gabourey is the only student who implies that speed may be indicative of mathematical competence. She contends that stronger students “get it faster” than other students and claims that they turn in their tests first because they are “always the first to answer.” Although she recognizes it as a component at points in our discussion, in other places Gabourey seems to downplay the importance of speed, except, perhaps, in game-playing contexts. Such inconsistency reflects the instability inherent in adolescent self-beliefs. It also suggests, perhaps, movement away from an orientation that appears to privilege more instrumental understanding as it stresses merely the expediency of procedural fluency.

Although they refrain from using the language of *adaptive reasoning*, participants include it as a component of competence. Kilpatrick, Swafford, and Findell (2001) define adaptive reasoning as “the capacity for logical thought, reflection, explanation, and justification” (p. 116). Half of the participants recognize teaching and explaining to others as vital in establishing mathematics competence.

Gabourey asserts the necessity of talking about mathematics and explaining it to others. Similarly for Tyson, mathematics competence is demonstrated in the ability to explain mathematics to others and to facilitate the understanding of others. As a result of his collaborative classroom experiences, Omari values the ability to teach as an index of competence.

Omari and Tamar extend the profiles of mathematics competence to include the ability to demonstrate or defend mathematical positions and arguments. In Omari's class, the goal is not only to find solutions, but also to "debate what our answer means." Presentation, explanation, and argumentation are prominently featured in his competence profile. Kilpatrick, Swafford, and Findell (2001, p. 129) assert that in mathematics:

> Answers are right because they follow from some agreed upon assumptions through a series of logical steps. Students who disagree about a mathematical answer need not rely on checking with the teacher, collecting opinions from their classmates, or gathering data from outside the classroom. In principle, they need only check that their reasoning is valid.

Omari has opportunities to engage in such adaptive reasoning as he and his classmates engage in his Montessori classroom's *Math Seminar* where problems are posed, hypotheses are advanced, and solutions are argued.Tamar likewise insists that competent students are "able to demonstrate what they mean." They possess an "ability to model and represent quantities, expressions, and equations." Kilpatrick et al (2001) maintain that "analogical reasoning, metaphors, and mental and physical representations are 'tools to think with,' often serving as sources of hypotheses, sources of problem-solving operations and techniques, and aids to learning and transfer" (p. 129). Tamar joins Kilpatrick et al in broadening the notion of adaptive reasoning to include not only informal explanation and justification, but also "intuitive and inductive reasoning based on pattern, analogy, and metaphor" (p. 129).

Other components of participants' profiles of mathematics competence are subsumed under Kilpatrick, Swafford, and Findell's notion of productive disposition. According to these researchers:

> Productive disposition refers to the tendency to see sense in mathematics, to perceive it as both useful and worthwhile, to believe that steady effort in mathematics pays off, and to see oneself as an effective learner and doer of mathematics.

Although some participants exhibit more apprehensive self-concepts, they still see the value in a productive disposition. For example, in her poem Aminah describes feeling "uneasy [w]henever I get a new problem," and maintains that often "nothing makes sense. But she talks about a seventh grade experience where her teacher facilitated her understanding and, consequently, her enjoyment of mathematics. Aminah longs for mathematics to make sense and views this capacity as a competence criterion. Although he has demonstrated more consistently strong performances in mathematics, Bryan is at least as frustrated by it as Aminah. It is significant for Bryan that mathematically competent individuals demonstrate a type of readiness that allows them to accomplish mathematical tasks "on their feet." For Bryan, the mathematically competent are able to access a "plethora of new methods … to solve the problem." This is the case not only because these individuals possess strategic competence that directs their approaches to solving problems. It is also because a productive disposition enables these individuals to see mathematics as sensible and understandable.The component of mathematical competence under the productive disposition strand also encompasses perceiving mathematics as both useful and worthwhile. All participants recognize the "importance" of learning mathematics. For most of them though it is useful to know and worthwhile learning to the extent that it is a vehicle for them to access professional and career goals or simply as a stepping stone to graduation. Half of the participants incorporate this component by emphasizing the usefulness of mathematics in daily life. Aminah insists that "when you relate math to stuff you do every day, it makes it easier to understand it." Gabourey is unequivocal in emphasizing the importance and ubiquity of mathematics. She asserts that mathematics is "very useful," and that "math is in almost everything. So, you have to learn it." Even more fundamentally, Bryan considers mathematics as "the art or science of just taking numbers … and applying them to everyday life. Likewise, his brother, Tyson, posits that the competent practitioner of mathematics consistently engages in explorations "to cope with everyday needs." The goal of proficiency—or competence—in mathematics, and the understanding that comprises it, becomes facilitated by a productive disposition that appreciates the utility of mathematics.

Other findings shed light on these students' beliefs regarding the "nature-versus-nurture" conundrum or—as it is seen by these students—translated to mathematics competence as "effort-versus-ability." Effort, as an element of the kind of productive disposition that partly constitutes mathematical competence, is almost unanimously endorsed. Perhaps because she realizes that the efforts she exerts are not commensurate with her competitive grades, Tamar is the only student who does not explicitly cite effort as significant in comprising mathematics competence. She encourages "listening" and "paying attention," which she maintains describes much of the extent of her efforts. Tamar does not associate competence with "how hard you study," but supports individuals doing "the best to your ability." Similarly, Gabourey prioritizes working diligently as she highlights that when students try and "don't get it," that "at least they tried" and "gave their all." Unlike Tamar, though, Gabourey emphasizes the significance of effort and hard work, and establishes that they are important in deepening mathematical understanding. Gabourey and Aminah specify efforts of studying and practicing problems. Bryan points out the need to be willing to do "a lot of long, hard work" as Omari insists upon "putting enough effort in it." Tyson not only affirms that effort is essential, he distinguishes that "you need to work hard and continually work hard in mathematics throughout your life to understand how to do it." For most of the participants, effort is necessary to mediate a more constructive relationship with mathematics. Diligent effort provides an avenue to achieve mathematics competence and strong mathematics self-concepts in the face of challenging content and histories of difficulty.

The consensus on natural ability as a mathematics competence component is not as uniform as it is for effort. The students who endorse natural ability generally do so from a vantage of familial awareness. They are keenly aware—and have been made aware—of individuals, or (family) histories of individuals, who possess mathematical competence in abundance. Conversely, these participants are also acutely familiar with family members whose ability may be lacking. Bryan and Gabourey each live in households where a brother, or a couple of brothers, demonstrates particularly strong mathematics proficiency. Also in their households are stories of at least one parent's successful navigation of mathematics. Bryan acknowledges that "for some, math comes so natural for them," yet asserts that "they still have to put in some effort." On the other hand, Gabourey maintains that those who are more naturally predisposed, "don't need to work at all, … they just get it."

A number of participants simultaneously endorse and reject notions of natural ability. For example, Aminah notes that her mother "isn't really good at math." She believes that her mother's displeasure for mathematics "rubbed off" on her. In another instance, she indicates she does not subscribe to the belief that it is "a genetic thing, or that your parents pass it down through the genes," but it makes sense to her that "if your parents understand mathematics well, then it is likely that their children will too." Tyson also hints that both ability and affinity can be passed down from a parent. Even though he acknowledges natural ability, Tyson stresses that engaging in continuous study is able to prevail over "the math gene."

Only two students fail to espouse natural ability. Although Tamar inherits from her father rich stories of her family's talent in mathematics and attributes some of her capabilities to her family's strength in this area, she does not believe that natural ability should be a mathematical competence component. She recognizes it as "just an advantage." Omari neglects to advocate natural talent as an important component of mathematics competence. He is the considerably elder sibling of adoptive parents who express mathematics apprehension. Although Omari has not inherited their apprehension, as he was adopted in infancy, he may not be as privy to the knowledge of his birth parents' acumen or to stories about their abilities. It is possible that Omari's omission of natural ability may result from the scarcity of these details.

The distinctions between endorsements of effort and natural ability encourage a parallel discussion about incremental and fixed personal theories of intelligence. Dweck, Chiu, and Hong (1995) distinguish two theories of intelligence. The incremental theory posits that intelligence is expandable and malleable. The fixed theory assumes that intelligence is a fixed entity. As participants ardently insist on the importance of effort as a competence component, they simultaneously endorse an incremental view of intelligence and competence as improvable. And when participants suggest, instead, that ability is inherited, they imply that intelligence and competence are limited—or, at least considerably less expandable.

These correlations have implications for both factors and the ways that they are organized in the productive disposition strand of mathematics proficiency. Kilpatrick, Swafford, and Findell (2001, p. 132) point out:

> Students who view their mathematical ability as fixed and test questions as measuring their ability rather than providing

> opportunities to learn are likely to avoid challenging problems and be easily discouraged by failure. Students who view ability as expandable in response to experience and training are more likely to seek out challenging situations and learn from them.

Bryan and Tyson, respectively, typify the students that Kilpatrick et al reference.Aminah and Tamar are similar examples. Yet, despite the views of ability and intelligence participants subscribe to, the almost unanimously cite effort, or "hard work," as a principle mathematics competence component.

According to Kilpatrick, Swafford, and Findell (2001), the final component of the productive disposition strand of mathematical proficiency is the tendency to see oneself as an effective learner and doer of mathematics. In other words, its seems that a healthy mathematics self-concept contributes to establishing competence in mathematics. To examine the extent to which participants espouse belief in this strand, it is necessary to investigate the factors they affirm inspire such self-visions. Participants' mathematics self-conceptualizations will be more specifically attended to in the following section.

The factors that participants mention as essential to mathematics competence and that constitute the productive disposition address affective, attitudinal aspects of mathematics learning. These aspects are primarily motivational and address issues of interest, determination, and persistence. Tyson states succinctly, "You don't learn mathematics, if you're not willing to learn it. He uplifts "the want to learn mathematics." He sees being good in mathematics as consistent with " taking great joy and great excitement in learning the subject. Although he finds little joy or excitement in mathematics, Tyson's brother, Bryan, maintains the need to demonstrate interest through actions such as taking notes, and asking questions. He also recognizes the need to be dedicated to the domain of mathematics. Such dedication and persistence often leads to achievement. Omari links achievement and persistence to a student's mathematics efficacy. Gabourey, who shares Bryan's history of anxiety towards mathematics, views motivation in the face of challenge as vital in the construction of mathematical competence. She posits, "You gotta endure it [mathematics]" and points out the necessity to "push yourself, even though you think you might not be good at math." Pushing oneself may involve "doing more and seeking out assistance," as Aminah prescribes, to build competence in mathematics.

Seeking out assistance is one of the ways that two of the participants identify competent mathematics students. It marks, and positions, them as effective learners. In addition to its role in constructing competence, Bryan points out that asking questions suggest levels of interest and determination to understand. Tamar also relates asking for help to the developing "a better understanding" of mathematical concepts and, consequently, enhancing mathematics competence. Perhaps, because of his experiences in his *Math Seminar* where students ask questions to guide their inquiry, Omari advocates asking questions as evidence of mathematics proficiency.

Seeking out assistance—especially by asking questions—is a demonstration of engaged participation. It is an engaged participation that communicates, "I am a competent learner and doer of mathematics. Interestingly, the participants who refer to participation do not find it significant in establishing competence. Aminah does, however, relate participation to understanding and confidence. She judges the confidence of students based on their participation. Confidence helps to construct a productive disposition. Also, Aminah argues, "If you don't understand, … then you're not gonna participate that much." She links understanding to confidence and the participation that may be a likely consequence. Tamar views participation as even less central. She contends that as long as you "grasp the concept" of the mathematics lesson, and you are able to complete the assignments with minimal difficulty, then "participation doesn't really matter." The irrelevance of participation to competence, for Tamar, could be connected to her tendency and preference to work independently.

Working independently surfaces in Tamar and Omari's discussions about mathematical competence. Tamar describes her mathematics class as "pretty smart and pretty independent," characteristics she attributes to the mathematically proficient. Tamar points out that she takes it upon herself to alone at her own pace: "[My teachers] don't tell me what to do. I just do it." So, for Tamar part of being mathematically competent involves having the insight to know what to do on your own (strategic competence), and the initiative to execute mathematical activities without being led through each series of steps to find solutions (productive disposition). This is likely the case even though Tamar inclination towards independence is also fueled by the lack of support she has found in some of her interactions with teachers.

Omari's engagement in the *Math Seminar* in his classroom potentially fuels his espousal of working independently as a competence component. He enjoys the responsibility and autonomy he feel entrusted to him in the Montessori setting, through opportunities to teach himself, work in groups, and move at his own pace. Omari distinguishes that the ability to balance working independently with working collaboratively through asking and answering questions indicates competence. Omari's mathematics confidence and efficacy allow him to perform as independently, and as collaboratively, as he wants to be in his class.

It is worth mentioning components that are somewhat surprisingly absent from students' discussions of criteria for mathematics competence construction. The capacity to memorize and the achievement of grades are among these relatively discounted qualities. Gabourey surmises that "being good in math takes intelligence, some patience, and some memory. She emphasizes that one "can't just memorize it," but instead has to "learn it." Although she casts memorization in a light that contrasts learning, Gabourey affirms the important ability to remember, but not necessarily to memorize. This is fairly consistent with Tyson who privileges comprehension and ingenuity over memorization. Tyson admits that he does not have "a photographic memory," but acknowledges that he "can remember how to solve something, not exactly memorize a certain formula for how to do something. On the other hand, his brother, Bryan, boasts a more impressive memory, but concedes that reliance on memorization is inadequate in establishing and demonstrating competence. Aminah adds that memorizing fails to foster understanding “how to do it for yourself. For Aminah and the other participants memorization is an instrument or tool that allows further contemplation. It is not a proxy for the mathematical comprehension that these students prioritize. Although the process of memorizing as an end in itself is largely discounted, the practical significance of memory is not entirely discredited.

Participants also offer references to grades more as incentives or sources of motivation than as indicators or signs of mathematical competence. Although this group of fairly high achieving students shared histories of good grades, they did not view them as essential components—nor guarantors—or competence. And as they generally maintain expectations of strong academic performance, grades appear to be a consequence of competence rather than a component of it. Half of the group makes explicit its contempt for the grade of C. Aminah remarks that her fourth grade C in mathematics was the only such grade she had received in the subject and that the grade “made me think I wasn’t good in math, because a C is not a good grade.” Motivated by high grades, Bryan also recalls the feelings of distress he associated with obtaining a C during a grading period. He remembers feeling, “It’s going down from here.” Tamar frankly expresses that a “C is just unrespectable.” Although a number of other students of mathematics might argue the merits or value of such a C, these students, accustomed to B’s and A’s often in a series of gifted and accelerated courses, recognize the C with its implied acceptable mediocrity as, perhaps, an affront to their strong academic identities. This is likely the case even in instances where their mathematical identities are catching up to their academic identities.

In summary, participants' beliefs about what comprises mathematics competence largely align with Skemp's notion of relational understanding and Kilpatrick et al's concepts of multiple strands of mathematical proficiency. Participants prefer an orientation towards relational understanding, which privileges knowing what to do and why, over instrumental knowledge, which prescribes following rules without reasons. Students prioritize the strands of conceptual understanding and procedural fluency as they emphasize understanding mathematical concepts and appreciating their applicability in solving problems. Students in this study value being able to represent problems (and solutions), and the capacity to justify their approaches. These qualities are consistent with Kirkpatick et al's notions of strategic competence and adaptive reasoning. Participants also suggest the need to possess qualities of a productive disposition. In other words, it is essential to these students that in order to gain mathematics competence, individuals tended to be able to make sense of mathematics, and perceive that it is worthwhile and useful. More salient in participant narratives were the ideas about the benefits of their efforts in producing understanding and the perspective to see themselves as effective learners and doers of mathematics. These self-perceptions are subsumed under the self-concept.

Research Question Two

What mathematics self-concept beliefs are held by a sample of adolescent African American students?

In the seminal book *Conceiving the Self*, Morris Rosenberg (1986) delineates in detail notions of self-conceptualizations. He defines the extant self-concept as "what… the individual sees[s] when he looks at himself" (p. 9). Rosenberg asserts that explorations into the self-concept must consider the parts, the relationship among the parts, the ways of describing both parts and whole, and the boundaries of the object. He refers to these as the content of the self-concept, the structure, the dimensions, and the ego-extensions, respectively. Although the self-concept on which Rosenberg focuses his attention is the broader, more global self-concept, his text has implications for and offers insight into the mathematics self-concept, which is encompassed by the broader global self-concept. As such, the mathematics self-concepts that the study participants reveal will be analyzed attending to the considerations that Rosenberg outlines. This study focuses primarily on the content, yet incorporates other elements an attempt to provide a rich description of the nature of the participants' beliefs. Although Rosenberg delineates dispositions, social identity elements, and physical characteristics as comprising the content of the self-concept, this research exclusively examines only the first two components. Information regarding participants' dispositions and social identities are revealed in various data including graphical social knowledge structures (SKS), questionnaires, inventories, and interviews.

As students mature and engage in social learning, they come to view objects and themselves in terms of abstract categories (Rosenberg, 1986). They begin to see themselves as "a person with certain tendencies to respond, that is, with dispositions" (p. 15). For the participants in this study, these dispositions refer to attitudes, traits, abilities, values, and personality traits. Rosenberg points out that to a large extent, the content of the self-concept is made up such abstractions: "The self perceived by the young child is largely a concrete, material reality. With maturation and learning, however, the individual comes to conceptualize the self in terms of more abstract response tendencies or potentials, consisting largely of dispositions or traits" (p. 209).

Social Knowledge Structures. The social knowledge structure (SKS) sheds light onto the traits and dispositions that participants see in themselves as the construct their mathematics self-concept. The schematic used in this dissertation is a modification of the graphic representation of Greenwald, Rudman, Nosek, Banaji, Farnham, and Mellot (2002). The graphical structure reflects associations among self-concept, self-esteem, stereotypes, and attitudes. During my dissertation research, participants created two different social knowledge structures, with the second one being composed approximately one year after the first. Details from participants' social knowledge structures provide glimpses of aspects of their global and mathematics self-beliefs. The SKS provides a graphical representation of how the students view and describe themselves. The SKS also offers insight into the personal and academic identities of the participants. Participants' SKS compositions are found in Appendix J.

All participants identify themselves as "student[s]" on their SKS. Tamar includes the distinguishable self-descriptions of "knowledge seeker." Tyson even notes the distinction of being a "Pre-IB [International Baccalaureate] student." He appears to take pride in being distinguished academically, as this distinction finds its way into his self-representation. Aminah, Gabourey, and Tamar add to their description of themselves the word "learner," or "learning" (Aminah). Omari, however, is the only participant who not only identifies himself as a "student," but he also views himself as a "teacher." A vital part of Omari experience as a student of mathematics—and one that he values—is the capacity to teach. This capacity to teach himself and others features prominently in his mathematics competence and self-concept beliefs.

In their SKS graphics, most participants also make references to their intellectual proficiency. Brothers Bryan and Tyson give identical self-descriptions as "intelligent." Aminah and Gabourey describe themselves as "smart." Perhaps in a less confident moment, Aminah lists the description "smart-ish" to describe herself. Her description likely stems from the feelings of being "average." Along with describing himself as "intelligent," Tyson also uses "smart" and "knowledgeable" as descriptors. As such, he uses the most direct references to his intellect in his social knowledge structures. Conversely, the students who display perhaps the strongest mathematics self-concepts—Omari and Tamar—do not use any of these references to characterize their academic acumen.

Although every participant identifies as a "student" or "learner" and several incorporate descriptions of intelligence in their self-depictions, none identifies in a way that is explicitly or exclusively mathematical—despite differing levels of achievement, interest, and engagement. The structure of the self-concept considers the relationship of the various parts of its content. It takes into account the psychological centrality of a construct. Rosenberg explains, "The significance of a particular component depends on its location in the self-concept structure—whether it is central or peripheral, cardinal or secondary, a major or minor part of the self" (p. 18). It seems that the greater goal for these participants is the maintenance of strong academic self-concepts, which encompass, in many cases, strong mathematics self-concepts. In other words, all participants identify with academics, but not necessarily with mathematics. For students such as Aminah, Bryan, and Gabourey, academics are central to their self-concepts irrespective of their attitudes towards mathematics. Along with Tyson ("intelligent," "smart," "knowledgeable"), Aminah's social knowledge structure contains the most self-descriptions as scholastic ("learning," "smart," "smart-ish").

Inspection of participants' SKS representations suggests that other elements of their self-concept compete for attention. For example, Omari and Tamar exhibit the most robust mathematics self-concepts. Yet, they fail to include any of the descriptors (e.g., "smart," "intelligent," or "knowledgeable) in their SKS. Along with the other participants, they include certainly as many descriptors that have nothing directly to do with academics or mathematics. The number and variety of these self-descriptions make clear the hierarchical nature of the self-concept. As students view themselves as a "musician," or as a "reader," it becomes evident that the conceptualization of the self as a doer of mathematics is structured as multiple self-ideas make their bids for centrality in the self-concept.

Self-Description Questionnaire II. Participants also responded to the Self-Description Questionnaire II (SDQ-II) (Marsh, 1992). The SDQ-II is "designed to measure multiple dimensions of self-concept for adolescents" (p. 1). The instrument contains measures of three academic areas, including mathematics. This section focuses on data from items tailored to examine mathematics self-concepts. Participants were administered the SDQ-II twice with a year between administrations. In the tradition of Pietsch, Walker, and Chapman (2003) this study focused primarily on the ten items from the SDQ-II measuring self-concept for mathematics. The first administration of the SDQ-II to participants occurred during the summer or 2011. The second administration occurred late the following summer.

To get a general sense of participants' mathematics self-conceptualizations, the researcher reverse coded the negatively worded items and calculated participant averages. In 2011, the group mean was 4.67. Tamar and Omari had the highest averages of 6 and 5.6, respectively. Tyson's average was 5.1, also above the group. Aminah, Bryan, and Gabourey had averages below the group mean. Aminah's average of 4.4 was slightly below the group mean. Bryan had an average of 4.1. Gabourey had the lowest average at the time of 2.8. Therefore, from these 2011 scores, participants were ranked as high (Tamar and Omari), medium (Tyson and Aminah), and low (Bryan and Gabourey).

Not only do participants' responses yield information about the content and structure of their mathematics self-concept beliefs, but they also offer insight into the multiple dimensions of these attitudes. Rosenberg indicates that these dimensions of self-attitudes can differ in content, direction, intensity, salience, consistency, and stability among other things. He distinguishes these dimensions in the following manner (p. 24):

> If we can learn what the individual sees when he looks at himself (chiefly social identity elements, dispositions, and physical characteristics); whether he has a favorable of unfavorable opinion of himself (direction); how strongly favorable or unfavorable these feelings are (intensity); whether the individual is constantly conscious of what he is saying or doing … (salience); whether the elements of his self-picture are consistent … (consistency); whether his self-attitude varies from day to day … (stability); … if we can characterize the individual's self-picture in terms of these dimensions, then we have a good, if still incomplete, description of the individual's self-concept.

Participant responses on the SDQ-II provides glimpses into the content of their mathematics self-concepts by highlighting aspects of the dispositions students assume or adopt in their pursuit of competence in mathematics. These dispositions reinforce the traits that participants ascribe to themselves in the Rosenberg tradition. Participant ascriptions also hint at the attributes that they endorse in establishing productive dispositions for being competent, successful doers of mathematics. The salience dimension of the mathematics self-concept takes into account the psychological centrality embedded in the structure of the mathematics self-beliefs. Relative stability is explored as the degree of shifting in a participant's responses over the period of a year, and is displayed in graphical format in Appendix O.From the 2011 to 2012, Omari and Tamar are the most consistent in their responses on the SDQ-II. Their responses are remarkably stable over the year. This could suggest a more stable and robust mathematics self-concept. In each of the two SDQ-II administrations, Omari and Tamar give the highest responses to the items that address having *always done well in mathematics* and obtaining *good marks in mathematics*. In fact, in 2011 Tamar answered each item with the response that suggested the strongest mathematics self-concept. The only item on which both Omari's and Tamar's response changed was the one exploring their enjoyment of studying mathematics. While Omari reports enjoying studying mathematics more in 2012 than in 2011 (3 to 5), Tamar reports in her only change a slight depression in her enjoyment of studying mathematics. This is likely attributable to the number of interactions with teachers in which Tamar feels unsupported.

Tyson also demonstrates relative stability in his responses over the year. Along with Omari, and Tamar, Tyson considers mathematics as one of his best subjects. Tyson's most dramatic shift is in his response to item: *I often need help in mathematics*. His response changes from 2 to 5, indicating that this description suits him well. Tyson's responses are consistent with and supported by his interview data. In his interviews, Tyson acknowledges needing more help in recent mathematics coursework, despite a healthy mathematics self-concept. Tyson's other more significant shift (from 2 to 4) is on the item stating, *I do badly in tests of mathematics.* His transition from a small, independent institution to a larger, public school are certain to contribute to Tyson's changing self-description. Also, Tyson points out that he sometimes loses points on tests on less challenging problems as he focuses primarily on problems that require greater understanding. He maintains that his preoccupation with such challenging mathematics problems distracts him sometimes from completing all problems. His preoccupation also sheds light on the things he emphasizes in establishes his competence in mathematics.

Like other participants, Omari, Tamar, and Tyson's responses indicate that they are determined to develop and maintain productive dispositions. Whether motivated by an interactive seminar in mathematics, by an interest in numbers and patterns, or by the challenge of difficult problems, they are driven to see mathematics as sensible. They believe that mathematics—and achievement in mathematics—is useful and worthwhile. These participants steadfastly believe that their efforts to gain competence will be rewarded by achieving that goal. These attributes help Omari, Tamar, and Tyson to view themselves as capable and effective students of mathematics. Their development of such productive dispositions strengthens their confidence in their knowledge and ability (Kilpatrick, Swafford, and Findell, 2001).

Unlike Omari, Tamar and Tyson, Aminah, Bryan and Gabourey do not identify mathematics as one of their "best subjects." Instead, Aminah considers it as her worst and "the opposite of everything that I love." Bryan and Gabourey begin 2011 reporting that this statement is far from how they would describe themselves. Their self-conceptualizations position mathematics as far less central than for other participants. Yet, academics, in general, remain psychologically central in the structure of their self-concepts. Although both Bryan and Gabourey change their responses in the next year, they change them, by the same amount, in different directions. Bryan moves slightly further away (to the extreme end of the scale) from this statement being descriptive of him. Gabourey, on the other hand, shifts her response in a slightly more positive direction, indicating that math is becoming a better subject for her. Like his brother, Bryan notes that he *often needs help in mathematics* now more than before. Bryan expresses that this is most descriptive of him. Despite her strengthening mathematics self-concept, Gabourey's indicates no change (5) in her response to this item, suggesting the she too feels that she continues to need assistance in mathematics. Bryan and Gabourey's responses display less stability than Omari, Tamar, and Tyson's and suggest that more productive mathematical dispositions may indeed exhibit greater stability.

Aminah, Bryan, and Gabourey make substantial changes in addressing, *I look forward to mathematics classes.* Aminah and Bryan mirror each other's change in this response (from 3 to 1). Their most recent responses indicate that they consider this description not like them at all and that they look forward to mathematics classes *less* than before. This could be a result of their histories of struggle and the intensity of their negative mathematics affect. Gabourey's shift reflects an inversion (from 1 to 3) of Aminah's and Bryan's. Like Tyson, Gabourey's change suggests that she looks forward to mathematics classes more. Her response marks the greatest positive shift in this item. Her shift is likely the result of the heightened sense of efficacy she has experienced in the last two years, and the confidence she is beginning to enjoy.

Bryan and Aminah find the item, *I have trouble understanding anything with mathematics in it,* more descriptive of them during the last SDQ-II administration. All other participant responses remained the same as the previous year. Bryan and Aminah also have in common that their response to *I enjoy studying mathematics* dwindles by two and one, respectively, even though they started at the same evaluation point (3) in 2011. Despite perhaps gaining confidence in mathematics, Gabourey assesses the degree that this item describes her as constant (3). Although she is enjoying some recent encouraging success—as manifested in her more productive disposition—her enjoyment of studying mathematics has yet to increase.

Since students often process and interpret information about themselves from the test performances, it is worthwhile to review participant response on the SDQ-II item that considers tests in mathematics. The degree to which students' grades are central to their academic self-ideas—and especially if mathematics grades are central to their mathematics self-concepts—indicates in their SDQ-II responses the degree to which students see themselves as successful doers of mathematics. Three of the six participants express that they *do badly in tests of mathematics* more in 2012 than in 2011. Although Omari and Tamar feel that this item hardly describes them at all, Aminah, Bryan, and Tyson each report that this item is now more descriptive of them. Tyson and Gabourey's changes within the year are inversions of each other. Tyson shifts from 2 to 4; Gabourey, from 4 to 2. Gabourey is the single participant who implies that she is doing better on her mathematics examinations.

These data are replicated in the next SDQ-II mathematics self-concept item, *I get good marks* [read: grades] *in mathematics*. Aminah and Bryan both answer with greater margins in their response from the previous year. That is, they feel in 2012 that this statement was even further away from how they would describe themselves. For Aminah and Bryan, the dimensions of direction, intensity, and stability of the self-attitudes communicate how much they both view themselves as perhaps further away from possessing the types of dispositions they feel necessary to gain and secure mathematics proficiency. Again, only Gabourey's response indicates that this item has increased suitably in describing her. The changes in content, pedagogy, and pacing of mathematics curricula as students progress through middle and high school possibly force the participants to face more rigorous coursework and tests. These results may reflect the contributions of adjustments to curricular and other structural shifts.

With the exception of Tyson and Aminah, every participant maintains a response indicating that the statement *I never want to take another mathematics course* is very much an inaccurate description of them. Although Tyson reported in 2011 that he considered this prompt an unlikely description (2) of him, a year later he reported, like his participant cohort, that the statement was most unlike him in description. In 2011, Aminah similarly reported that the prompt was most unlike her. Yet, in 2012 she shares that the description is more descriptive of her. Aminah is the only participant who reports that the statement more closely describes her. These data reflect participants' understanding of the importance of mathematics, which is indicative of a productive mathematics disposition. Aminah, echoing Gabourey, Aminah offers that mathematics is "pretty important [for me], since math is everywhere—even if you don't want it to be." Yet, her persistent struggles with the subject, combined with the anticipation of additional courses, possibly engender cumulative anxiety and exacerbate her apprehension.

Another SDQ-II item connects participants' histories and their expectations. Omari, Tamar, and Tyson each maintain consistent responses (6, 6, and 5, respectively) to the item: *I have always done well in mathematics*. This item appears to be relatively objective in that it is presumed to be verifiable by static academic records. However, responses from Aminah, Bryan, and Gabourey suggest that interpreting this item is not as apparent. Both Aminah and Bryan affirm in 2011 that the item is descriptive of them. In the next year, though, Bryan feels that it is less descriptive of him, while Aminah feels that the statement is considerably less descriptive of her. Their feelings could be attributed to increasing curricular content difficulty, and to the changing nature of interactions with teachers, and peers. Interestingly, Gabourey's response shifts from 1 to 3, indicating that she felt that the statement was most descriptive of her in 2011, but much less descriptive of her in the following year. Her recent success in understanding mathematics and her feeling like she "could do it and do it well" have bestowed to her a *present* that modifies her perception of her history.

The last mathematics self-concept item, *I hate mathematics*, gives more focused insight into the intensity and stability of students' affect in their mathematics self-conceptualizations. Omari, Tamar, and Tyson—who all report enjoying mathematics as a subject—offer stable responses from 2011 to 2012 indicating (by choosing "1") that this does not describe them at all. Gabourey exhibits, perhaps, the strongest display of initial contempt by responding with 4—more like her than not. Yet when she returns in 2012, Gabourey joins other participants and selects "1" as her response. Bryan exhibits a similar trend as he shifts his response from 3 to 1. Gabourey's and Bryan's changes imply that despite their shared histories of apprehension and anxiety in mathematics, that they hate mathematics less. This shift in their response could stem from the social interactions they engage in at (and outside of) their school to complete mathematical activities. The change could also be the result of them being resigned to the ubiquity of mathematics and surrendering to their estimations of its importance.

Attitude Towards Success in Mathematics. Information about participants' mathematics self-concepts can also be ascertained by examining their responses on the *Attitude Toward Success in Mathematics* subscale of the Fennema-Sherman Mathematics Attitudes Scales (1976). Like the SDQ-II, the *Attitude Towards Success in Mathematics* subscale contains items that provide glimpses of participants' extant mathematics self-concept. And just as the SDQ-II does, the subscale reveals information about multiple dimensions (direction, intensity, etc.) of the mathematics self-concept. Participant responses are tabularized in Appendix Q.

On the *Attitude Towards Success in Mathematics Subscale*, Omari and Bryan offer the most affirmative responses to the positively phrased prompts. Each of them strongly agrees with all six of these items. Omari also strongly disagrees with all of the negatively worded prompts. The direction and intensity of their responses attest to the strength of his positive mathematics self-concept. For the most part, Bryan disagrees with most of these prompts also. And despite admitting to struggling with mathematics, the more *productive* components of his mathematical disposition see fruit from his determination to succeed in it.

Tyson's responses fairly closely follow a similar pattern as his brother Bryan—generally affirmative responses on the first half; generally negative ones on the latter half. Tyson and Bryan's answers typically differ by one increment, if any—with the exception of two responses. On the prompt *Winning a prize in mathematics would make me feel unpleasantly conspicuous* [The researcher interpreted and explained this item], Tyson and Bryan respond C and E, respectively. Bryan's strong disagreement hints that he may be more comfortable with the distinction of being recognized for achievement in mathematics. Bryan possibly values the views of others more than his brother. Tyson's relative neutrality potentially suggests a level of ambivalence toward the idea of winning a prize in mathematics. Alternatively, it could suggest that Tyson may be more used to doing well in mathematics and that he may be fairly accustomed to recognition for his being proficient. In any case, the centrality of mathematics achievement and recognition features more prominently in the case of Bryan than for Tyson.

Bryan typifies how participant responses can incorporate reflected appraisals and psychological centrality in forming mathematics self-beliefs. Rosenberg (1986) explains that the principle of reflected appraisals holds that "people, as social animals, are deeply influenced by the attitudes of others toward the self and that, in the course of time, they come to view themselves as they are viewed by others" (p. 63). Rosenberg further delineates three subordinate principles of direct reflections, perceived selves, and the generalized other:

> The first refers to how particular others view us, the second to how we believe they view us, and the third to the attitudes of the community as a whole; these are internalized in the "me" and serve as a perspective for viewing the self.

One might think that Bryan's response to the prompt regarding winning a prize in mathematics may implicate him as putting perhaps greater stock in reflected appraisals than his brother, Tyson. However, when one considers the next item, *People would think I was some kind of a grind if I got A's in math,* a different possibility emerges. On this item, Tyson and Bryan respond D and B, respectively. While Tyson disagrees, Bryan concurs with the statement. This could say something about their relative peer groups and their positions within them. The dynamics of Tyson's peer group may encourage mathematics achievement as a mutual goal. Or there could be something about Bryan's interactions with his peers, such as teasing, competition, envy that could engender a more negative—or negatively perceived—response from his peers. Not as apparent is the case that despite the possible derision of his peer for his high mathematics achievement, Bryan (who would not feel "unpleasantly conspicuous" to win a prize in mathematics) values this type of achievement as psychologically central to his self-perceptions. One could also speculate that especially in mathematics—his subject of strife—would he feel rewarded by such accomplishment.Trends in the responses of female participants were less consistent with each other and with males. Surprisingly, Tamar did not agree with any of the 12 items. She disagreed with four of six positively phrased prompts, including ones about being *happy to get top grades*, and being pleased at *being first in a mathematics competition*. Tamar's responses could reflect her eschewal of attention, even though she performs strongly. Such attention is not so much looked upon with contempt, as it is considered something to be avoided. Tamar is not "in it for the glory," so to speak. Attention and recognition from others do not seem to be vital to her self-concept. In this light, however, it is also somewhat surprising that Tamar does not respond more definitively than C (uncertain) to the item: *Winning a prize in mathematics* *would make me feel unpleasantly conspicuous*. Tamar responded with indecision (C) to one-third of the subscale items, suggesting that she is either uncertain or ambivalent about (recognized) success in mathematics. Reflected appraisals, including direct reflections, perceived selves, and the generalized other are featured less centrally in the structure of her mathematics self-concept.

Aminah answers with the most—five in all—responses of uncertainty (C). Although she strongly agrees that she would be *happy to get top grades in mathematics* and that *being regarded as smart in mathematics would be a great thing*, she is unsure about how *proud* and *happy* she would be to be recognized as an excellent or outstanding student. Aminah offers two main reasons for the nature of her responses. The first is related to her history and consequential expectations: "I don't really expect it to happen. I don't really think about it that much, since it hasn't happened." Because it has not happened, she feels, Aminah does not fully consider the possibility of her being recognized for being competent, and certainly skillful, in mathematics. As such, it is almost as if the consideration is not worth entertaining because of its *improbability*. Aminah may not consider herself in these scenarios for another reason: "I don't think I'm smart in math. So, I don't really give it much thought, ... what people would think." More of how Aminah feels about the impact of the thoughts of others—at least about her performances in mathematics—is highlighted in the following exchange:

Interviewer: Let's say you were a very strong math student. Would it matter to you if people knew or did not know that or believed or did not believe that?

Aminah: No, it wouldn't.

Interviewer: Okay. Why would it not?

Aminah: It doesn't really affect things. I don't see why they would care.

Interviewer: Okay. Does what they think affect you?

Aminah: Not really in math. 'Cause I mean, no.

Aminah attaches irrelevance to other people's knowledge of, and possibly acknowledgement of, her mathematics ability. This irrelevance may be rooted in the likelihood that mathematics is not essential to Aminah's identity, which is suggested where she qualifies her final statement ("Not really *in math"*).

Although she imitates Omari's strong disagreement with the negatively worded items (e.g., If I had good grades in math, I would try to hide it; I don't like people to think I'm smart in math), Gabourey's responses on the positively phrased first half of the subscale varies. Some of Gabourey's responses on this section, however, seem contradictory. Although she strongly agrees that she would *be happy to get top grades in mathematics* and that it would be *great to win a prize in mathematics*, Gabourey responds with uncertainty (C) to the prompt, *Being first in a mathematics competition would make me pleased*. And although she agrees that she would be *proud to be the outstanding student in math*, she is likewise uncertain (C) that it she would be *happy to be recognized as an excellent student in mathematics*. Perhaps Gabourey is concerned about the extent of the recognition that some of the prompts lead her to imagine. Or maybe Gabourey's gregarious disposition may find certain levels of competition uncomfortable, as those levels might impinge on her social interactions. Or these responses that appear to be contradictory attest to the dynamic and developmental nature of Gabourey's self-beliefs. She confirms what Rosenberg (p. 23) notes: "Seemingly contradictory self-attitudes are also common."

Research Question Three

In what ways do these students reveal that they construct these math competence and self-concept beliefs?

Danny Martin (2007) asserts that "very little of the research that has been conducted about African Americans in mathematics has been based on their first-hand accounts of their mathematical experiences" (p. 148). As this study explores the mathematics competence and self-concept beliefs of six of these students, it has a goal of uplifting the voices to enrich of knowledge of what these beliefs are and the ways that students come to these conceptualizations. In the construction of their mathematics competence and self-concept beliefs, participants draw from their experiences of mathematics socialization. They also construct their ideas as they fashion their mathematics identities. According to Martin (p. 150), *mathematics socialization* "refers to the experiences that individuals and groups have within a variety of contexts such as school, family, peer groups, and the workplace that legitimize of inhibit meaningful participation in mathematics." He states that *mathematics identity* "refers to the dispositions and deeply held beliefs that individuals develop about their ability to participate and perform effectively in mathematical contexts and to use mathematics to change the conditions of their lives" (p. 150). These key concepts are useful in examining how the participants in this dissertation research come to construct their mathematics self-ideas.

Mathematics Socialization

According to Mead, the self emerges from social experience, especially social interaction (Rosenberg, 1976). Participants express their experiences mathematics socialization through reporting elements of their social identity and contributions from interactions with significant others (such as teachers, parents, and peers) among the components of their mathematics self-beliefs. Social identity includes classifications of gender, race, family status, occupation and other socially defined categories. This study primarily considers the dynamics of some of the interactions that frame participants' mathematics socializations. This research pays attention to gender and racial aspects of participants' social identities and attempts to interpret the influence of these on their beliefs about mathematics competence and their mathematics self-concepts.

Rosenberg (1986) explains the perceived self as "an individual's concept of how others judge and evaluate him" (pp. 85-6). Further, interpersonal valuation refers to the concern individuals have about others' opinions of them. Rosenberg establishes that the association between the perceived self and self-esteem is stronger "if the particular other is really significant to the individual" (p. 87). In other words, it matters more if the favorable opinion of the other is highly valued. Rosenberg affirms that interpersonal significance depends on interactions, "[b]ut such interaction is not random; to a considerable extent it is determined by social structural forces" (p. 95). These structural forces, according to Rosenberg, help to structure socially defined positions and status. Furthermore, Rosenberg posits that the significant others with whom we most interact are determined by our role set, which describes the "complement of role relationships which persons have by virtue of occupying a particular social status" (p. 95). Finally, he maintains that the role set practically exhausts an individual's significant interactions with parents, siblings, teachers, friends and classmates.

Martin (2007) also underscores the importance of these relationships in the development of students' mathematics socialization and identity. He asserts that an analysis of students' becoming doers of mathematics must occur simultaneously with considering their racial identities. He argues (p. 148):

> One challenge is to *document* both episodes of mathematics participation or experience in which racial identity assumes salience, and episodes in an individual's racial-identity development in which prior mathematical experiences assume salience. It is equally important to document and understand how school, peer, family, community, and societal forces contribute to the development of these identities [emphasis in original].

This research synthesizes components of Rosenberg's emphasis on role sets and significant others and Martin's framework for analyzing mathematics socialization and identity among African American students by giving particular attention to student interactions with teachers, family, and peers, as they are also highlighted by participants.*Teacher Interactions*. In their discussions about their experiences with mathematics, participants reveal that interactions with their teachers, family—especially parents, and their peers, are central elements that are incorporated into both their established and developing mathematics self-beliefs. Displays of teacher care, especially to the more socially sensitive, pique participant interest and encourage them to persist in the face of challenge. Participants identify the multiple ways that teachers demonstrate caring attitudes and how their teachers' dispositions can inspire changes in their mathematics self-concept beliefs. Students also reveal how detrimental to their self-perceptions some interactions with teachers can be.

Participants share that some of their interactions with teachers helped to shift their attitudes about mathematics and their abilities in mathematics. In essence, these educators played a role in these students (re)constructing the conceptualizations of themselves—and their identities—as mathematically competent individuals. Gabourey recalls one of her teachers "changed [her] thoughts about math." She also credits her sixth and seventh grade mathematics teachers for positively shifting her math self-concept. These teachers helped Gabourey know and believe "I was able to do it [mathematics], and do it well."

Tyson and Bryan also remember teachers who were instrumental in them (re)forming their ideas about mathematics and/or about themselves as doers of mathematics. For instance, Tyson points out that Mrs. Leonard and Mr. Evans not only made learning interesting and exciting, but also that from their teaching, he realized that "math could be understood by learning and studying to the best of my ability." These teachers released him from the realm—where Aminah often finds herself trapped—where “nothing makes sense” in mathematics. Bryan names Mrs. Leonard and Mr. Evans as his two best mathematics teachers and attributes his own perseverance through years of struggling with mathematics to his teachers’ assistance and to their forever enduring encouragement.”

Aminah boldly links teachers’ competence as educators to their students’ confidence with the subject being taught. She argues, “ If a teacher does a good job teaching and explaining the subject, then their students will become more confident of their ability.” Aminah even recollects a period when she “actually started enjoying math more ‘cause I had a really good teacher, and I understood everything. This teacher helped Aminah to understand and enjoy mathematics, and possibly helped her to (re)view her ideas about her capacity for competence in mathematics.

Participants also report that their feelings that teachers care about them often facilitate their openness to engage and persist in mathematics. Students hardly offer vague generalities restricted to discussions of “warm fuzzies.” Rather, they described specific acts under a broad umbrella of the teacher care many of them, fortunately, experienced. Several participants offer that teachers’ efforts to help them understand mathematics powerfully and effectively demonstrate that they care. Aminah maintains that such exemplary teachers illuminate content and adjust pacing so that students have time to understand. Gabourey also appreciates teacher care in helping her to understand by taking time to answer questions (practice problems). Likewise, Bryan values a teacher volunteering to tutor him.

Gabourey is heartened by the morning and recess help that her teachers offer. She highlights that her seventh grade teacher "really care[s] about teaching us something." Similarly, Tyson points out that one of his teachers, Mr. Frantz, "wanted us to learn concepts," and that this teacher "changed my understanding." For Omari, teachers demonstrated care in the accessibility and personal attention they extended to him. Omar also considers, to some degree, the expectations he interprets from his teachers as measures of their care for him as a mathematics student. For example, Omari cites a teacher checking over his work "more than [over] other students," as an indication that this teacher cares enough about him to expect *more* from him. These various instances of teacher care (wanting students to learn and understand, taking needed and extra time to answer questions, and expecting them to perform to high standards) catalyze reactions—and interaction—between students who interpret these actions and teachers who engage in them in a way that forges greater mathematics competence and stronger mathematics self-concepts.

Just as interactions with teachers can help lead students move toward stronger self-ideas, they can also usher students in the direction of weaker self-beliefs. Gabourey attributes her withdrawal from mathematics and from mathematics class to teacher she found especially "tough." Gabourey writes in her mathematics autobiography about a discouraging time: "I was failing and there was just a point where I gave up and felt like I couldn't do it. What caused that was my teacher." Aminah correlates more directly her sense of her mathematical self and her interactions with her teacher: "I got behind in math, 'cause my teacher wasn't great." Aminah is particularly critical of teachers who are poor classroom managers. She is frustrated by a teacher who "really doesn't address things." Instead, the teacher "sits at her desk and does whatever she does for the last hour of class."

Tamar is the most critical of her teachers. This is not surprising in light of the fact that her interviews did not organically yield stories of favorable interactions with them. Like Aminah, Tamar detests the poor classroom management of a teacher who "couldn't keep class going," and who, instead, would issue imperatives: "'Do your work! Don't talk too loud!'" Another teacher "talked too much" about irrelevant material and was "just there." She also describes a recent mathematics course as "just class" where they "don't really do anything." Tamar recalls teachers whose tone grew more aggressive and others who thought she was "going to fail" because of her expeditious execution of assigned activities with minimal regard to teachers' repetition and review. These incidents of negative interactions with teachers, for Tamar, attenuate her interest in mathematics classes and—to some degree—mathematics. They also help foster her spirit of independence and estrange her from a desire to participate. Tamar's robust and, at this point, stable mathematics self-concept perhaps has allowed her to weather these interactions better than a student whose self-perceptions these instances would threaten more. At any rate, participants make clear that the dispositions that educators adopt and display, along with the characteristics they assume and demonstrate, and the pedagogies they embrace and implement significantly contribute to the degree that they are able to assist students in the construction of robust mathematics identities and self-concepts. It is noteworthy that the influence of teachers' interactions is in both positive and negative direction of mathematics self-concept.

Family Interactions. In addition to interactions with teachers, in their discussions participants view their families as strong influences on their self-beliefs. Their households are often the first places where participants are socialized to expectations of understanding and achieving in mathematics. The significance of the contributions of the family to participants' construction of mathematics competence and self-concept beliefs is most evident in the multiple ways that participants are positioned—and position—in their households. In each case, participants live with at least one parent (though interacting with both), and at least one sibling. Participants also refer to extended family members, such as uncles, aunts, and grandparents in their discussions.

The most clearly stated relative positioning that the participants talk about is with respect to their sibling(s). For example, Bryan views his twin brother, Tyson, as possessing more creativity and ingenuity than he does himself. Therefore, he views Tyson as better suited for mathematics. Aminah has a brother two years younger than she from whom she sometimes seeks mathematics assistance—implicitly positioning him as [more] mathematically competent and skillful. Gabourey, the youngest in her household, has two brothers who are "really good at math." She relates that she "want[s] to be as smart as them, " effectively exalting them to her standard of mathematical *smartness*. Tamar has an older brother (by two years) who is also mathematically capable, but hardly refers to his schooling, except in mentioning a period during which she felt her father needed to focus more attention on his progress. Tyson hardly speaks to Bryan's mathematical abilities either. But he admires his abilities to write and to memorize. Omari is older than his brother by six years and foregoes discussing his relative proficiency because the large age gap makes such comparisons less meaningful.

Much of the discussions about family centers on the influence of interactions with parents. To slightly varying degrees, the families confer upon their children expectations of academic, including mathematics, success. Omari's mother asserts that she needs people to expect Omari to be mathematically knowledgeable. Gabourey is clear that her parents "really want me to do well." She maintains, "They expect me to get A's," and to "give 100%." Her mother, Mrs. Watkins, also points out that her children "have to pass Mommy." The Hammer household (Bryan and Tyson) likewise maintains high expectations for all of their children. Tamar affirms that she is familiar with the high expectations her mother and father have for her. These participants often incorporate their parents' expectations of them into their goals to achieve mathematics competence.

The expectations parents have for their children are buttressed by the support they provide to make their mathematics competence and achievement more probable. Parents actively seek out academic and enrichment opportunities to supplement the mathematical development of their children. These include elementary school programs that target *gifted* students (Tyson), and summer academic enrichment programs hosted by universities (Omari). In some instances, parents provide tutors not only for remedial support, but also to maintain and extend understanding and for preparation, as in the cases of Aminah, Tyson, and Bryan. The availability of family members as exemplars of mathematically competent also provides a source of academic support to participants. In Tamar's case, her father, provided homeschooling in her early years. In addition to her tutor, Aminah is able to rely on her brother, an uncle, an aunt, and her grandfather for assistance. Gabourey has the strength of her brothers' ability at her disposal. The proximity and availability of these family exemplars likely provides an intimacy that allows for levels of encouragement and motivation that can be more effectively tailored to participant needs than they may be able to find from teachers or peer groups.

In most cases, parents are particularly intentional about the environments to which they expose their children. They aim to create at home settings that are conducive to their children's advancing mathematics competence. The Hammer household insists on lending Bryan and Tyson material support through tutors and supplies and psychological support by encouraging and motivating them toward strong academic performances and attitudes of persistence. Bryan and Tyson's parents are deliberate in their attempts to imbue them with a strong sense of self-confidence and agency. The Watkins (Gabourey) family is careful to establish a home that fosters a climate of striving for the highest possible levels of accomplishment. They find for Gabourey practical assistance in the form of manipulatives, supplemental texts, flash cards, etc.). And although he considers his parents as more mathematically challenged than he, Omari is proud of the lengths they will go to in order to provide him with an environment where his academic and mathematics proficiency can flourish. He believes that he is fortunate to have parents who "would do anything they can to help me." This includes staying up with him until 3:00 am. Parental actions such as these attest to the high expectations that these families have for their children. These actions also demonstrate that parents participate with their children as they construct beliefs about themselves in the pursuit of competence in mathematics.

Outside of the household, parent efforts to advocate for their children confirm messages participants hear and interpret. These messages usually affirm parents' beliefs about their children's ability and the importance of their earnest pursuit of mathematics competence. For example, despite Aminah's pleas for the contrary, her mother sought Aminah's placement in a seventh grade advanced mathematics class because her test scores met the requirements for eligibility. Bryan and Tyson's parents have been aggressive in finding programs and schools that provide opportunities that they deem suitable for their children. Parents, such as the Hammer family, insist that these programs provide environments of challenge where their children can experience both the struggle that accompanies education and the accomplishment that comes from achieving levels of success. As these participants witness their parents advocating for them, they can infer that their family expects them do be mathematically proficient, that they are determined to provide resources to facilitate this objective, and that they are willing to convince decision makers about the appropriateness of the goal. Participants can see in their parents advocacy that this goal is not a mere fantasy that is just beyond their grasp, but that it is a close or present reality that is tangible and believable—even if not quite yet by them. It should be noted, however, that since all six participants have been enrolled in the Channel the Challenge (CtC) program by their parents, that the sample of students' parents included in this study may not be typical of larger population of parents today.

Peer Influences. The influence of peers is especially significant during adolescence (Manning & Butcher, 2009). Although participants interact with teachers and family members daily to varying degrees, the nature of peer interactions differs in that—unlike the extent of the power differential within their relationships with teachers and parents—peer relationships tend to exhibit a greater concentration of more symmetrical displays of power, and perceptions of power. That is, power is often (perceived to be) more evenly distributed. Participants' peers are more like them. As such, the networks they establish and maintain provide information to participants about not only their peer but also about themselves by extension. The participants in the study gain this information through engaging in positioning their peers. Positioning of themselves among their peers allows participants to orient their goals relative to their peer group—

finding motivation or, perhaps, discouragement—and to emerge more deeply convinced of their own self-perceptions.

Participants position the mathematics competence of their friends, classmates, and themselves within their peer network. The objective of the Hammer family for their sons Bryan and Tyson to associate with “like-minded” peers committed to pursuing academic excellence seems to be realized in their children’s interactions with others. Bryan describes his friends largely in two groups: “gifted in math,” or “gifted all around.” But when asked to describe the things he respects, admires, and wants to imitate about his friends he names things other than their mathematics competence. Instead, he highlights things such as their friendship, sportsmanship, and congeniality. His statements indicate the things that Bryan values in an individual at least as much as their capacity for mathematics comprehension. It may be that this capacity for mathematics need not be explicitly stated in this gifted network.

The question may be how Bryan views himself as a result of his peer interactions. In other words, how does he position his own abilities relative to his peers’ abilities? Bryan and Tyson’s parents implore them to seek the company of those “smarter than them.” Bryan classifies his peers as “extremely intelligent.” If Bryan’s network of friends reflects his attempts to fulfill this encouragement, then his attempts suggest—in his estimation—a subordination of his proficiency to his friends’. Oddly, though, Bryan’s mother judges that he “does better than 95% of kids.”

Tamar and Aminah see most of their friends as “pretty smart,” and “very good” in mathematics, respectively. Although Aminah views her own abilities as “pretty normal,” she indicates that many her friends are in more advanced courses. This difference likely heightens the separation she considers between herself and mathematics proficiency. The separation she feels may even be more acute as Aminah finds that her peers try to help her by explaining mathematics to her. Unlike Aminah, Tamar views her friends as “on the same level” as she. She points out that, like her, they are fairly independent. Because Tamar sees within herself the intelligence and independence she values as competence components, she understands her proficiency to be at least commensurate with her classmates. Tyson also attests that most of his friends are “good in math.” Yet he admits that they are not all quite as conscientious as he. They “don't want to put in as much effort,” positioning himself as more earnest and diligent if not more competent.

Gabourey sometimes retreats in the presence of what her mother calls “bright shining stars.” Whereas Bryan and Tyson may seek out these exemplars with their parents’ approval for their peer network, Gabourey is less eager for these students’ company. This suggests that she may be somewhat intimidated by or, certainly, uncomfortable in the midst of the brilliance of others. Conversely, she expresses that she is more comforted by witnessing other students need for mathematical support and assistance—a consolation she shares with Aminah. The consolation of knowing that others need help signals identification not with the superstars of mathematics who can operate more independently, but rather with those who require additional instruction and explanation.

Omari sees himself as part of a "community" which provides an environment conducive to learning and achievement. He believes that his peers view him as a "good math student." Omari sees himself as "ahead of most people" in his class and often helps other students. Because he is in a position to assist his peers in many instances, Omari comes to be known—and to know himself—as a proficient doer of mathematics.

The peer groups that participants mention often motivate each other. Tyson and Omari report how individuals within these groups help and push each other. They both share incidents of collaborating on assignments and staying up late to complete particular task with classmates. Gabourey refers to friends she calls by telephone to discuss mathematics. She mentions a friend who sits next to her, even before the teacher, as a first recourse if she needs assistance. As Gabourey and Aminah seek and accept help from their peers, they likely position their own and their peers' competence in different ways than Tamar and Omari who, in turn, more often offer and distribute help and motivation to their classmates.

Mathematics as a Male Domain. One of the ways participants shed light into their gender associations with mathematics is through their responses on the *Mathematics as a Male Domain* subscale of the Fennema-Sherman Mathematics Attitudes Scales (1976). Like the *Attitudes Towards Success in Mathematics* subscale, the *Mathematics as a Male Domain* subscale consists of six positively stated and six negatively stated items. Respondents choose from five alternatives: strongly agree, agree, undecided, disagree, and strongly disagree. The *Mathematics as a Male Domain* items, along with participant responses are found in Appendix P.

Participants generally do not support the notion that mathematics is a male domain. They tended to agree, or strongly agree, with positively stated items such as *I can trust a woman just as much as a man to figure out calculations*; they tended to disagree, or strongly disagree, with negatively stated items such as *Mathematics is for men; Arithmetic is for women*. Participants were unanimous in the their strong agreement with three prompts: *Females are as good as males in geometry*, *Studying mathematics is just as appropriate for women as for men*, and *Girls can do just as well as boys in mathematics*. Occasional departures from these trends suggest that the belief that mathematics is for males is far from abandoned, though.

Although most students respond definitively, the uncertainty of some participants' responses hint that there may be some hesitation in their commitment to their beliefs about gender equity in mathematics ability. And although Tamar is consistent with the participant cohort in responding to the six positively stated items, she selects the "uncertain" response for a number of negatively stated items, such as *It's hard to believe a female could be a genius in mathematics*. She chooses the uncertain response for half (six) of the subscale items. When Tamar exclaims, "This whole thing is sexist," her response is also a likely result of her frustration and contempt for the instrument. Her exclamation possibly constitutes, for her a (re)action of resistance.

Gabourey's singular item of uncertainty is somewhat peculiar. Yet, this perceived aberration discloses more about the nature of her apprehension about mathematics. She chooses the response of uncertainty to *Males are not naturally better than females in mathematics.* This choice is peculiar because only in the previous item, Gabourey indicates that she strongly agrees that *Girls can do just as well as boys in mathematics.* In our final interview, Gabourey maintains that neither girls nor boys are better in mathematics:

> I think we're the same. Some people may be [better], but it [gender] doesn't matter. I think there's an equal amount of people in the world that are smart. I guess. They're not naturally either, like boys aren't naturally better than girls and girls aren't naturally better than guys. It just depends on the person.

Although her response may appear unusual given this stance, Gabourey's choice becomes less peculiar when one considers her closest community—her family household, populated by mathematically "brilliant" brothers and a father who is known to have been mathematically astute. Gabourey's mother's mathematics proficiency—or at least the narrative of it circulated in her household—is positioned as less developed or pronounced as Gabourey's father's. Also, Gabourey's older sister shares her interest in other subjects, such as reading and writing, and is less confident in her mathematics ability. Through this (family) community lens, Gabourey's choice may be less surprising.Aminah reveals similar ambivalence. Aminah strongly agrees with five of six positive phrased items and strongly disagrees with all of the negatively phrased items. Even though she agrees that *Women certainly are logical enough to do well in mathematics*, her response on this single item is slightly less intense than the extreme response she gives to the remaining items. Like Gabourey, insight into Aminah's household is illuminating. She identifies with her mother from whom she believes she inherited distaste for mathematics. Aminah also resides in a household with a younger brother who demonstrates impressive proficiency in mathematics. Aminah's father, who died in her youth, is also reported to have had facility in mathematics. So, her response to this item could reflect both how she may attribute the fact that mathematics makes little sense to her to her being a female, and how she may perceive that the mathematical strength in her family community is disproportionately distributed to males.

Participants' responses may reveal what Holland, Lachicotte, Skinner, and Cain call the "contours of culture that shape the self in profound ways" (p. 21). In other words, participants' responses are not only expressions of their mathematics identity, but also manifestations of the ways that they have been (mathematically and otherwise) socialized largely through interactions with teachers, family, and peers. Holland et al. would argue that student responses—from rejecting the notion of mathematics as a male domain to observing (or interpreting) gender differences in mathematical ability—provide clues to cultural discourses from home, school, and beyond the combine with self-discourses to construct self-conceptualization.

Mathematics Identity

Holland, Lachicotte, Skinner, and Cain (1998, pp. 23-4) affirm:

> In the post-Enlightment West, the scientific management of populations places people in categories that determine the treatment they receive … schools. Technical categories, such as … "at risk" children, the argument goes also enter into or return to everyday discourse, and so are used in schools and other institutions. People learn to treat one another and themselves according to these categories.

They point out that social constructivists stress that these "discourses" construct both subjects and subject positions. Social positions "become dispositions through participation in, identification with, and development of expertise with the figured world" (p. 136). Holland et al (p. 137) maintain, "The development of social position into positional identity—dispositions to voice opinions or to silence oneself, to enter into activities or to refrain and self-censor, depending on the social situations—comes over the long term." They also posit that this development comes in the course of social interaction.If one views mathematics learning as a figured world, then one comes to understand, as Holland et al point out, that the parts of the figured world carry dispositions and social identification as certainly as they carry meaning. The identities of position that participants experience and assume in this figured world are related to the self-conceptualizations that they fashion. Martin (2007) specifies that a *mathematics identity* encompasses an individual's self-ideas and how others see the individual in the context of doing mathematics. Martin (p. 150) asserts that the mathematics identity "is always under construction, and results from the negotiation of our own assertions and the external ascriptions of others." As such, the mathematics self-concepts and mathematics identities reveal the contributions from reflected appraisals, psychological centrality, and self-attributions. The principle of reflected appraisals holds that individuals, "as social animals, are deeply influenced by the attitudes of others toward the self and … they come to view themselves as they are viewed by others" (Rosenberg, p. 63). The notion of psychological centrality refers to the hierarchically structured nature of the self-concept and addresses whether or not a particular component is central or peripheral. Self-attributions provide information as to how individuals explain the causes of particular outcomes involving themselves.

The Multidimensional Inventory of Black Identity-Teen (MIBI-T). The Multidimensional Inventory of Black Identity-teen (MIBI-T) is designed to assess three stable dimensions of racial identity: centrality, regard, and ideology. The MIBI-T has seven subscales with three questions each. The influence of reflected appraisals is evident upon examining the Regard dimension of the MIBI-T. Regard refers to a person's affective and evaluative judgment of his/her race (Scottham, K., Sellers, R., & Nguyen, H., 2008). Private regard describes the degree to which individuals feel positively/negatively towards African American and their membership in that racial group. Public regard refers to the degree to which individuals feel others view African Americans positively/negatively. A summary of participant responses to the MIBI-T appears in Appendix K.

On two of three items addressing private regard (*I am proud to be Black and I am happy that I am Black*, the participants all unanimously *really agree.* On the third private regard item, I feel good about Black people, male participants Bryan, Omari, and Tyson either *kind of agree*, or *really agree*. Aminah and Gabourey choose a neutral response to this item. So, while male participants indicate stronger agreement, female participants articulate less certainty in their private regard.

Participants incorporate the generalized other in their responses to items about public regard. For instance, all respondents tend to disagree that *Most people think that Blacks are as smart as people of other races*. Aminah, Gabourey, and Omari also disagree that *People think that Blacks are as good as people from other races*. Bryan is the only participant who agrees with this statement, as his brother chooses a neutral response. Bryan reverses the case on the final public regard item. He is the single participant who *really disagrees* that *People from other races think that Blacks have made important contributions*. Other respondents either agree or really agree.

Bryan may feel that people view Black people as "good as other races" in the sense of them being human and deserving respect as such. However, his responses make clear that he believes that others do not recognize Black people as smart or as having made important contributions. As a matter of fact, all respondents uniformly respond low in public regard as they reflect on how they believe others view the intellect of Black people.

These attitudes about the generalized other intersect with various levels in Martin's interpretive framework for analyzing the mathematics socialization and mathematics identity of African Americans. The masternarrative that has been generated—and continues to be circulated—about the inferior intellectual capacity of African Americans—intersects with the sociohistorical level of Martin's framework. The discourses surrounding such a masternarrative can be found in also at the community level as families search for academic enrichment program for the children, and at the school level where teachers are genuinely surprised at the proficiency demonstrated by African American children doing mathematics. Holland, Lachicotte, Skinner, and Cain (1998, p. 27) make the claim that

> Socially constructed selves … are subject to positioning by whatever powerful discourses they happen to encounter—changing state policies that dictate new ways of categorizing people in the census, educational diagnostics that label some children "at risk," or new forms of racist discourse taken up from right wing talk shows.

As participants construct their mathematics self-views, it is clear that they do being mindful of the reflected appraisals of the generalized other which—according to data from public regard items on the MIBI-T—position them as academically, and more certainly mathematically, incompetent if not inferior.Racial classification is one of the primary ways that Americans engage in social identification. As social identity comprises one aspect of the content of the self-concept, attention to its centrality is warranted. As a dimension of concern on the MIBI-t, centrality indicates how much race is at the core of an individual's self-concept. One of the prompts on the inventory is, *If I were to describe myself to* *someone, one of the first things that I would say is that I'm Black*. Tyson is the only participant who strongly agrees with the statement, indicating that racial identity as Black or African American may not be central to participants' self-concept. Although this item suggests what may be a more peripheral racial identification, on a different item, Tyson and Omari indicate a greater degree of racial centrality. They both agree that they *have a strong sense of belonging to other Black people*. The paucity of African American students—particularly males—that Tyson and Omari report in their academic courses could inspire a greater sense of belonging in the African American community. All participants, including Tyson and Omari, indicate that they *feel close to other people*. In their interviews, Aminah and Gabourey point out that many of their friends and associates are not African American. Although they, along with Bryan, make clear the closeness they feel to others, it is Tyson and Omar who indicate the belonging they feel "to other Black people."

Items from the ideology dimension of the MIBI-T also provide information about the centrality of race in their self-concepts. Ideology refers to "one's philosophy about the ways that members of the African American community should act" (Scottham, Sellers, Nguyen, 2008, p.2). Participants' responses to a few of these items suggest their tendency toward a humanist ideology. This humanist philosophy emphasizes what humans have in common, rather than highlighting differences among them.

Participants' responses to two items provide more evidence that being African American may not be central to the self-concept of these participants. One of the prompts is, *Being an individual is more important than identifying yourself as Black*; the other prompt is, *Blacks should think of themselves as individuals, not as Black*. Aminah, Gabourey, and Omari are consistent in their responses of general and strong agreement, indicating a centrality of human-ness or personhood, rather than African American-ness or Blackness. However, Bryan and Tyson's responses are more inconsistent and shift in a way that mirrors each other's changes. Bryan *really agree*s with hierarchizing the importance of being an individual and is uncertain about Black people thinking of themselves as individuals. Tyson, on the other hand, is uncertain about prioritizing the importance of being an individual, yet strongly agrees that Black people should think of themselves as Black. Bryan and Tyson's responses indicate how tenuous the formation and confirmation of ideas surrounding racial identification can be, especially in the formative, developmental stages of adolescence.

The concept of ego-extensions also becomes relevant in discussing centrality and the self-concept. Rosenberg (1986, p. 34) states:

> Ordinarily we think ourselves as bounded by our skins: there we start and there we end, and ever it shall be. And yet each of us knows that the self stretches out to encompass elements external to it. We at once recognize the independent entity of these external things, people, or groups but at the same time feel they are a part of us—indeed, that in a sense they *are* us (emphasis in original).

The closeness that participants feel to other people in general, and the belongingness to other African Americans that Omari and Tyson express, manifest how they extend the boundaries of self to extend to other individuals. To a degree, by demonstrating the things and people to which participants broaden their self-notions, they also reveal what components are central to their self-conceptualizations.The social knowledge structures shed light into whether and how students come to view themselves as doers of mathematics, in the sense of identifying with mathematics. For example, almost all participants identify as "creative" (Gabourey, Omari, Tamar, and Tyson). Although she does not use the word "creative," Aminah, along with Omari, describes herself as a "musician," and as "musical." Bryan is the only participant who does not identify as a creative person. It is interesting that this is the very type of person that Bryan feels he needs to be in order to be competent and successful in mathematics. He sees the creativity and ingenuity in his brother Tyson as one of the reasons Tyson does well in mathematics.

Bryan is an example of how individuals take personal assessments of themselves and evaluate the tasks they face, and then determine—based on the fit of their inventory and the task needs—their likelihood of being competent (and to what degree) in the endeavor. He sees mathematics as a creative endeavor. He views himself as lacking "a natural gift for mathematics, or anything related to it." Therefore, Bryan feels that it requires more (effort) for him to understand and be proficient in mathematics. It is not surprising, then, to find that in his SKS he describes himself as “hard working” and “determined.” These descriptors attest to the resilience that Bryan forges to extend his competence in mathematics.

Conversely, the majority of other participants (with the exception of Tyson) seem to believe that mathematics has no use for creativity and, in some cases, for them. Although Tamar demonstrates talent in mathematics, she does not see use for creativity in the subject. Aminah, who values her creative side, perhaps, as much as Tamar does, also does not see a place for (her) creativity to serve her in pursuing her mathematics competence. Therefore, Aminah positions herself outside the realm of mathematics proficiency.

Other instances support the notion that participants engage in constructing their mathematics competence and self-concept beliefs by evaluating the degrees of congruence in their classification of mathematics as a discipline and their characterizations of themselves as individuals. For example, Aminah describes mathematics as “the opposite of everything that I love.” She views mathematics as closed to creativity: “I don’t think creativity has anything to do with math at all.” So, Aminah feels out of sync in mathematical exploits. For her, it is “just hard … harder than other things.” Tyson states that a “brainiac” or “nerd” would be the type of person who would be “good at learning mathematics.” Prominently in his self-description—in conversations and in graphical representation—Tyson identifies himself as a “nerd.” Therefore, Tyson finds it easier to connect with mathematics and progress in his competence in it because he perceives himself to be open and amenable to its study.

Summary and Recommendations for Further Research

Findings from this study shed light on the abundant opportunities to engage in research that privileges the voices of adolescent African American students who have often been kept at the margins of discussions focusing on group performances in mathematics. In adopting Martin's (2000) framework for analyzing for mathematics identity and mathematics socialization among African American students, this dissertation study has implications for various groups invested in the mathematical intellectual achievement of these students. By delineating sociohistorical, community, school, and individual forces that influence mathematical socialization and mathematics identity, Martin also encourages us to consider these areas as we contemplate implications of our investigation for policymakers and educational researchers, for families and communities, for teachers and schools, and for students of mathematics.

Policymakers. Attention to sociohistorical influences is necessary as it "refers to the historically based discriminatory policies and practices that have prevented African Americans from becoming equal participants in mathematics and other areas of society" (Martin, 2000, p. 29). Such policies and practices should be among the things that policymakers fight vigorously to overcome. It is at the policy level that gaps in quality of service to minority students of color and their families should be highlighted, as these gaps have typically been submerged in discussions about competence and achievement (Steele, 2003).

Policymakers should be entrusted with addressing one of the more problematic aspects of the national conversation about the mathematical proficiency of different groups of students, and that is the failure to supplement data regarding the relative underachievement of African Americans with information about how successful environments promote high achievement among African Americans (Perry, 2003a). Policymakers are also instrumental in deciding the extent of the use of test scores and their interpretations in evaluating the mathematical competence of student. This is significant in that when competence and academic success are solely tied to performances on high-stakes tests, often schools are forced along avenues that are more limited to remediation and basics education (Leonard, McKee, & Williams, 2013). This essentially guarantees a substandard education to many of the African Americans who disproportionately populate these schools. Policymakers inherit the task of compelling communities to address gaps in achievements. One way that policymakers can move in this direction is to consider requiring that schools and school systems be evaluated by whether they have been able to promote achievement among students of color.

Educational Researchers. Policymakers can use the work of educational researchers to design and enact policies. Like policymakers, educational researchers can shift dialogues about mathematical competence from presuming that what works for one (typically White) child, also works for all children, to understanding that "the task of academic achievement for African Americans in the context of school in the United States of America is distinctive" (Perry, 2003, p.

6). To illuminate such distinctive differences in the mathematical experiences of African Americans, educational researchers can implement various conceptual and methodological shifts in conducting further research.

Although this dissertation used Martin's (2000) framework of mathematics identity and mathematics socialization to analyze the mathematics competence and mathematics self-concept beliefs of a group of African American students, alternative conceptual and methodological frameworks can be considered by educational researchers to supplement the research of this study. For example, positioning theory (van Langenhove & Harre, R., 1999) and the notion of figured worlds (Holland, Lachicotte, Skinner, and Cain (1998) can be used to frame further research efforts investigating mathematics identity and socialization, and mathematics self-conceptualizations. Also, this dissertation study encourages the continued use of identity as an analytic tool. This research suggests not only documenting long-term constructions (macro-identities) of who a person is (or presents him/her self to be), but also attending to the identities enacted in moments of time (micro-identities) to provide details about the ways that mathematical identity, learning, and activity are interrelated (Wood, 2013).

Methodologically, frameworks such as narrative inquiry and critical race theory should be considered as they privilege the stories and counterstories that individuals tell about their experiences. Although qualitative case study methodology provides rich details about the lived experiences of the participants, quantitative dimensions of mixed methods studies could be used to make inferences and examine trends about groups of individuals in ways that are limited by case studies. Since students are generally nested in classrooms (and types of schools) in districts, incorporating hierarchical linear modeling (HLM) may help locate concentrations of trends in particular attitudes of particular mathematics and self-concept beliefs. And while this dissertation study utilized various instruments (e.g., SDQ-II, MIBI-T, Fennema-Sherman Mathematics Attitudes Scales) as springboards for qualitative analyses, further research can employ more deliberate quantitative components and mixed methods. Also, incorporating differential item functioning (DIF) into quantitative analyses can enhance our understanding of assessment outcomes related to the teaching and learning of African American students (Tawfeeq, & Yu, 2013).

Families and Communities. In this study, parents and families were instrumental in creating (or finding) environments for the children where these children's ideas about their competence in mathematics could flourish, or be strengthened. Parents were intentional and proactive in seeking out these environments and opportunities. Families, and the communities they inhabit with their children, should aim to create multiple social contexts for African Americans where their identities as African Americans and doers of intellectual work are coincident (Perry, 2003). Families and communities are, therefore, responsible for assisting African American students in developing social, psychological, and political competencies—as well as academic competencies—as they commit to intellectual and cognitive work.

This study found that families, along with teachers and peers, were among the significant influences that participants mentioned in their interview sessions. In addition to interview with parents, though, future research should incorporate other essential relationships that participants name—including those with particular teachers, siblings, and friends. Such interviews would not only allow for greater triangulation and strengthen internal validity, but it would also enrich and add depth to the research.

Teachers and Schools. Participants in this study emphasized the role of teachers in the development of students' competence and mathematics self-concepts beliefs. As Perry (2003) maintains:

> A child's belief in the power and importance of schooling and intellectual work can be interrupted by teachers and others who explicitly or subtly convey a disbelief in the child's ability for high academic achievement, and the child having a rightful place in the larger society—unless a counternarrative about the child's identity as an intellectual being is intentionally passed on to him or her.

The centrality of teachers in the development of students' self-beliefs gives educators incredible responsibilities. From a Bourdieuian perspective, it is in academic culture that the mechanism for distributing educational opportunity resides (Perry, 2003b). Therefore, as schools transmit knowledge into cultural codes, teachers become essential in this process. Whose actions get constructed as *competent* and the ways that this occurs are largely influenced in classrooms by teachers. By their nature, schools and school personnel serve as both locations and means not only for interracial interactions, but also as means for affirming or challenging prior attitudes and understandings about race (Lewis, 2003).Results from this study confirm that relationships students have with teachers can be transformative. In other words, teachers through their interactions are able to help students shift their identities and self-concepts. They are able to achieve this largely by enacting what students perceive as caring relationships. It is the task of teachers, therefore, to discover what this means for *their* students. It could mean tutorial assistance before school or during lunch, or communicative gestures during class time, or it could be conversations about marching band after school.

As teacher education programs assume some of the responsibility for training educators, these programs need to include in their curriculum ways to guide teachers in demonstrating care, including navigating demands and expectations for high standards of performance. Teacher education programs can also endorse teacher design and development of culturally relevant, cognitively demanding tasks. Programs should encourage the incorporation of different disciplines, paradigms, and perspectives of mathematical knowledge (e.g., ethnomathematics, indigenous mathematical knowledge systems) as teachers and schools design meaningful content and use appropriate pedagogies in order to acknowledge and advance alternative interpretations of competence in mathematics.

Participants named teachers more often with more affect than other significant contributors to their mathematics self-beliefs. Therefore, it becomes essential that teacher education program understand the responsibility that they have to raise teachers' awareness of the influence they have on the progression of students beliefs about their mathematics efficacy and motivation. Participants' descriptions of their experiences with mathematics highlight multiple types of pedagogies implemented by their teachers and promoted by their districts. Future research should have as a goal to examine the impact of these varying pedagogies, and the curricula they support, on the construction of mathematics self-concept beliefs of students. In light of participant narratives that emphasize the significant role of teachers, and teachers' inherently central role in enacting school, district, and personal pedagogies, teachers must be careful to develop skills that acknowledge and support affective dimensions of student motivation and self-concept, along with those that they seek to develop in content knowledge and pedagogy.

Students. The most elemental level of Martin's (2000) framework concerns intrapersonal influences on mathematics identity and socialization. Therefore, these implications conclude with those regarding the individual. It is worth noting though that, in each case, these implications and suggestions are not limited to the group they are ascribed to in this closing pages. Holland et al (1998) claim that "if we are alive … then we are engaged in answering what is directed to us. We are always engaged in the activity of making sense of what is happening as one who will respond" (p. 278). In their pursuit of academic competence and intellectual achievement, students must be allowed to respond by embracing an ideology of intelligence as malleable and changeable, not fixed and determined. Adopting such an ideology could help students begin to counteract some of the threats to their self-concepts imposed by persistent stereotypes and prevalent narratives about negative ability. Although this signals an individual response, arriving at the point of this decision likely occurs well after interactions at sociohistorical, family and community, and school levels.

Conclusion

There is a great deal of discussion about "achievement gaps" in mathematics in the United States. Much of the conversation starts and remains fixed on the relative scores in the mathematics domain that students of different races obtain. Although researchers and policymakers are able to glean information and make inferences about some matters, the portrait that they gain is incomplete. There is considerably less attention that focuses on the lived experiences of the children who do not fare as well, as a group, on these assessments. It becomes relevant and important to consider how these students, as opposed to test and policy makers, view competence in mathematics and how they view themselves in regards to race and mathematics achievement. How African American students arrive at these conceptualizations may help the education community in its attempts to better understand the nature of differences in mathematics achievement.

This dissertation research establishes that its participants participate in positioning themselves and others along a continuum of mathematics competence. Participants' positioning incorporates discourses that are augmented primarily through their interactions with teacher, family, and peers. Significantly, participants indicate that they are keenly aware of the often-depressed expectations educational environments have of their mathematics ability. The ways that they navigate these implicit expectations and ability stereotypes—ignoring, modifying, or challenging—indicates, to some degree, participants' convictions about how they view themselves and their mathematics ability. This research highlights not only African American participants who *are* achieving in mathematics but also, for some of them, the additional struggle of developing and maintaining robust mathematics identities and self-concepts in the face of often diminished expectations.

I conclude this dissertation study with a charge to stakeholders in educations, that is, to all of us. In order to more effectively combat the deleterious effects of negative ability stereotypes and low competence expectations, it is necessary that we move from our tendency of gazing at gaps in achievement score to turning a more introspective gaze inward to examine the patterns of our own behaviors. Such a shift is imperative, as it will enable us to explore the ways that we may be complicit—as educators, parents, siblings, mentors, and policy makers—in preserving, even benignly, or in generating, perhaps unintentionally, discourses and practices that inhibit the production of our children's identities of competence and achievement.

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Appendix A:
SDQII

SDQII©

Self Description Questionnaire II

All information supplied will be kept strictly confidential.

NAME: **AGE:** **(years)** **(mths)** **DATE: / /**

MALE/FEMALE (circle one) PROGRAM: **GROUP**

PLEASE READ THESE INSTRUCTIONS FIRST

This is not a test - there are no right or wrong answers.

This is a chance for you to look at how you think and feel about yourself. It is important that you:

- are honest
- give your own views about yourself, without talking to others
- report how you feel NOW (not how you felt at another time in your life, or how you might feel tomorrow)

Your answers are confidential and will only be used for research or program development. Your answers will not be used in any way to refer to you as an individual.
Use the six-point scale to indicate how true (like you) or how false (unlike you), each statement over the page is as a description of you. Please do not leave any statements blank.

1	2	3	4	5	6
False Not like me at all; it isn't like me at all	Mostly false	More false than true	More true than false	Mostly true	True This statement describes me well; it is very much like me

Statement		False					True
01.	MATHEMATICS is one of my best subjects	1	2	3	4	5	6
02.	Nobody thinks that I am good looking	1	2	3	4	5	6
03.	Overall, I have a lot to be proud of	1	2	3	4	5	6
04.	I sometimes take things that belong to other people	1	2	3	4	5	6
05.	I enjoy things like sports, gym, and dance	1	2	3	4	5	6
06.	I am hopeless in ENGLISH classes	1	2	3	4	5	6
07.	I am usually relaxed	1	2	3	4	5	6
08.	My parents are usually unhappy or disappointed with what I do	1	2	3	4	5	6
09.	People come to me for help in most SCHOOL SUBJECTS	1	2	3	4	5	6
10.	It is difficult to make friends with members of my own sex	1	2	3	4	5	6
11.	People of the opposite sex whom I like, don't like me	1	2	3	4	5	6
12.	I often need help in MATHEMATICS	1	2	3	4	5	6
13.	I have a nice looking face	1	2	3	4	5	6
14.	Overall, I am no good	1	2	3	4	5	6
15.	I am honest	1	2	3	4	5	6
16.	I am lazy when it comes to things like sports and hard physical exercise	1	2	3	4	5	6
17.	I look forward to ENGLISH classes	1	2	3	4	5	6
18.	I worry more than I need to	1	2	3	4	5	6
19.	I get along well with my parents	1	2	3	4	5	6
20.	I am too stupid at school to get into a good university	1	2	3	4	5	6
21.	I make friends easily with boys	1	2	3	4	5	6
22.	I make friends easily with girls	1	2	3	4	5	6
23.	I look forward to MATHEMATICS classes	1	2	3	4	5	6
24.	Most of my friends are better looking than I am	1	2	3	4	5	6
25.	Most things I do, I do well	1	2	3	4	5	6
26.	I sometimes tell lies to stay out of trouble	1	2	3	4	5	6
27.	I am good at things like sports, gym, and dance	1	2	3	4	5	6
28.	I do badly on tests that need a lot of READING ability	1	2	3	4	5	6
29.	I don't get upset very easily	1	2	3	4	5	6
30.	It is difficult for me to talk to my parents	1	2	3	4	5	6
31.	If I work really hard I could be one of the best students in my school year	1	2	3	4	5	6
32.	Not many people of my own sex like me	1	2	3	4	5	6
33.	I am not very popular with members of the opposite sex	1	2	3	4	5	6
34.	I have trouble understanding anything with MATHEMATICS in it	1	2	3	4	5	6
35.	I am good looking	1	2	3	4	5	6
36.	Nothing I do ever seems to turn out right	1	2	3	4	5	6
37.	I always tell the truth	1	2	3	4	5	6
38.	I am awkward at things like sports, gym, and dance	1	2	3	4	5	6
39.	Work in ENGLISH classes is easy for me	1	2	3	4	5	6
40.	I am often depressed and down in the dumps	1	2	3	4	5	6

41.	My parents treat me fairly	1 2 3 4 5 6
42.	I get bad marks in most SCHOOL SUBJECTS	1 2 3 4 5 6
43.	I am popular with boys	1 2 3 4 5 6
44.	I am popular with girls	1 2 3 4 5 6
45.	I enjoy studying for MATHEMATICS	1 2 3 4 5 6
46.	I hate the way I look	1 2 3 4 5 6
47.	Overall, most things I do turn out well	1 2 3 4 5 6
48.	Cheating on a test is OK if you do not get caught	1 2 3 4 5 6
49.	I am better than most of my friends at things like sports, gym, and dance	1 2 3 4 5 6
50.	I am not very good at READING	1 2 3 4 5 6
51.	Other people get more upset about things than I do	1 2 3 4 5 6
52.	I have lots of arguments with my parents	1 2 3 4 5 6
53.	I learn things quickly in most SCHOOL SUBJECTS	1 2 3 4 5 6
54.	I do not get along very well with boys	1 2 3 4 5 6
55.	I do not get along very well with girls	1 2 3 4 5 6
56.	I do badly in tests of MATHEMATICS	1 2 3 4 5 6
57.	Other people think I am good looking	1 2 3 4 5 6
58.	I don't have much to be proud of	1 2 3 4 5 6
59.	Honesty is very important to me	1 2 3 4 5 6
60.	I try to get out of sports and physical education classes whenever I can	1 2 3 4 5 6
61.	ENGLISH is one of my best subjects	1 2 3 4 5 6
62.	I am a nervous person	1 2 3 4 5 6
63.	My parents understand me	1 2 3 4 5 6
64.	I am stupid at most SCHOOL SUBJECTS	1 2 3 4 5 6
65.	I have good friends who are members of my own sex	1 2 3 4 5 6
66.	I have lots of friends of the opposite sex	1 2 3 4 5 6
67.	I get good marks in MATHEMATICS	1 2 3 4 5 6
68.	I am ugly	1 2 3 4 5 6
69.	I can do things as well as most people	1 2 3 4 5 6
70.	I sometimes cheat	1 2 3 4 5 6
71.	I can run a long way without stopping	1 2 3 4 5 6
72.	I hate READING	1 2 3 4 5 6
73.	I often feel confused and mixed up	1 2 3 4 5 6
74.	I do not like my parents very much	1 2 3 4 5 6
75.	I do well in tests in most SCHOOL SUBJECTS	1 2 3 4 5 6
76.	Most boys try to avoid me	1 2 3 4 5 6
77.	Most girls try to avoid me	1 2 3 4 5 6
78.	I never want to take another MATHEMATICS course	1 2 3 4 5 6
79.	I have a good looking body	1 2 3 4 5 6
80.	I feel that my life is not very useful	1 2 3 4 5 6

81.	When I make a promise I keep it	1 2 3 4 5 6
82.	I hate things like sports, gym, and dance	1 2 3 4 5 6
83.	I get good marks in ENGLISH	1 2 3 4 5 6
84.	I get upset easily	1 2 3 4 5 6
85.	My parents really love me a lot	1 2 3 4 5 6
86.	I have trouble with most SCHOOL SUBJECTS	1 2 3 4 5 6
87.	I make friends easily with members of my own sex	1 2 3 4 5 6
88.	I get a lot of attention from members of the opposite sex	1 2 3 4 5 6
89.	I have always done well in MATHEMATICS	1 2 3 4 5 6
90.	If I really try I can do almost anything I want to do	1 2 3 4 5 6
91.	I often tell lies	1 2 3 4 5 6
92.	I have trouble expressing myself when I try to write something	1 2 3 4 5 6
93.	I am a calm person	1 2 3 4 5 6
94.	I am good at most SCHOOL SUBJECTS	1 2 3 4 5 6
95.	I have few friends of the same sex as myself	1 2 3 4 5 6
96.	I hate MATHEMATICS	1 2 3 4 5 6
97.	Overall, I am a failure	1 2 3 4 5 6
98.	People can really count on me to do the right thing	1 2 3 4 5 6
99.	I learn things quickly in ENGLISH classes	1 2 3 4 5 6
100.	I worry about a lot of things	1 2 3 4 5 6
101.	Many school subjects are just too hard for me	1 2 3 4 5 6
102.	I enjoy spending time with my friends of the same sex	1 2 3 4 5 6

Appendix B:
Multidimensional Inventory of Black Identity—Teen

Centrality

1. I feel close to other Black people.
2. I have a strong sense of belonging to other Black people.
3. If I were to describe myself to someone, one of the first things that I would say is that I'm Black.

Private Regard

4. I am happy that I am Black.
5. I am proud to be Black.
6. I feel good about Black people.

Public Regard

7. Most people think that Blacks are as smart as people of other races.
8. People think that Blacks are as good as people from other races.
9. People from other races think that Blacks have made important contributions.

Nationalism

10. Black parents should surround their children with Black art and Black books.
11. Whenever possible, Blacks should buy from Black businesses.
12. Blacks should support Black entertainment by going to Black movies and watching Black TV shows.

Humanism

13. Being an individual is more important than identifying yourself as Black.
14. Blacks should think of themselves as individuals, not as Blacks.
15. Black people should not consider race when deciding what movies to go see.

Assimilation

16. It is important that Blacks go to White schools so that they can learn how to act around Whites.
17. I think it is important for Blacks not to act Black around White people.
18. Blacks should act more like Whites to be successful in this society.

Oppressed Minority

19. People of all minority groups should stick together and fight discrimination.
20. There are other people who experience discrimination similar to Blacks.
21. Blacks should spend less time focusing on how we differ from other minority groups and
22. more time focusing on how we are similar to people from other minority groups.

Likert response scale is as follows:
1 _ really disagree, 2 _kind of disagree, 3 _ neutral, 4 _ kind of agree, 5 _ really agree

Appendix C:
Fennema-Sherman Subscales

C1: Mother Scale

1. My mother thinks I'm the kind of person who could do well in mathematics.
2. My mother thinks I could be good in math.
3. My mother has always been interested in my progress in mathematics.
4. My mother has strongly encouraged me to do well in mathematics.
5. My mother thinks that mathematics is one of the most important subjects I have studied.
6. My mother thinks I'll need mathematics for what I want to do after I graduate from high school.
7. My mother thinks advanced math is a waste of time for me.
8. As long as I have passed, my mother hasn't cared how I have done in math.
9. My mother wouldn't encourage me to plan a career which involves math.
10. My mother has shown no interest in whether or not I take more math courses.
11. My mother thinks I need to know just a minimum amount of math.
12. My mother hates to do math.

C2: Father Scale

1. My father thinks that mathematics is one of the most important subject I have studied.
2. My father has strongly encouraged me to do well in mathematics.
3. My father has always been interested in my progress in mathematics.
4. My father thinks I'll need mathematics for what I want to do after I gradate from high school.
5. My father thinks I'm the kind of person who could do well in mathematics.
6. My father thinks I could be good in math.
7. My father wouldn't encourage me to plan a career which involves math.
8. My father hates to do math.
9. As long as I have passed, my father hasn't cared how I have done in math.
10. My father thinks advanced math is a waste of time for me.
11. My father thinks I need to know just a minimum amount of math.

12. My father has shown no interest in whether or not I take more math courses.

C3: Teacher Scale

1. My teachers have encouraged me to study more mathematics.
2. My teachers think I'm the kind of person who could do well in mathematics.
3. Math teachers have made me feel I have the ability to go on in mathematics.
4. My math teachers would encourage me to take all the math I can.
5. My math teachers have been interested in my progress in mathematics.
6. I would talk to my math teachers about a career which uses math.
7. When it comes to anything serious, I have felt ignored when talking to math teachers.
8. I have found it hard to win the respect of math teachers.
9. My teachers think advanced math is a waste of time for me.
10. Getting a mathematics teacher to take me seriously has usually been a problem.
11. My teachers would think I wasn't serious if I told them I was interested in a career in science and mathematics.
12. I have had a hard time getting teachers to talk seriously with me about mathematics.

C4: Mathematics as a Male Domain

1. Females are as good as males in geometry.
2. Studying mathematics is just as appropriate for women as for men.
3. I could trust a woman just as much as I would trust a man to figure out calculations.
4. Girls can do just as well as boys in mathematics.
5. Males are not naturally better than females in mathematics.

6. Women certainly are logical enough to do well in mathematics.
7. It's hard to believe a female could be a genius in mathematics.
8. When a woman has to solve a math problem, it is feminine to ask a man for help.
9. I would have more faith in the answer for a math problem solved by a man than a woman.
10. Girls who enjoy studying math are a bit peculiar.
11. Mathematics is for men; Arithmetic is for women.
12. I would expect a woman mathematician to be a masculine type of person.

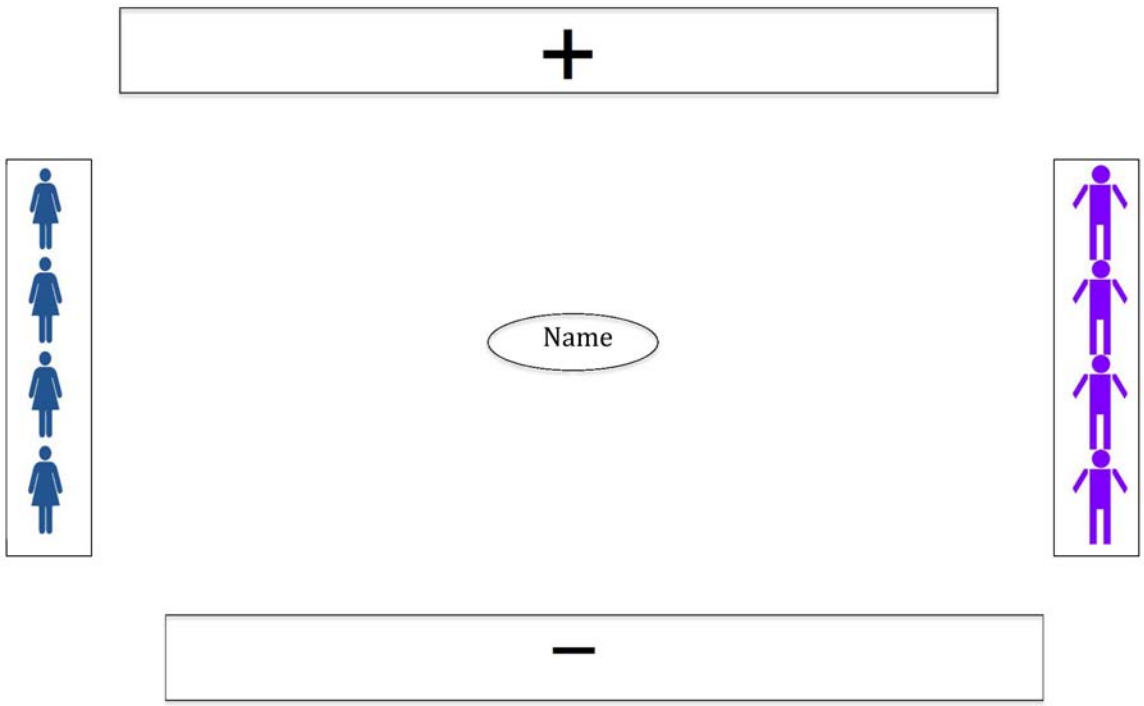
C5: Attitude Toward Success in Mathematics Scale

1. It would make me happy to be recognized as an excellent student in mathematics.
2. I'd be proud to be the outstanding student in math.
3. I'd be happy to get top grades in mathematics.
4. It would be really great to win a prize in mathematics.
5. Being first in a mathematics competition would make me pleased.
6. Being regarded as smart in mathematics would be a great thing.
7. Winning a prize in mathematics would make me feel unpleasantly conspicuous.
8. People would think I was some kind of a grind if I got A's in math.
9. If I had good grades in math, I would try to hide it.
10. If I got the highest grade in math I'd prefer no one knew.
11. It would make people like me less if I were a really good math student.
12. I don't like people to think I smart in math.

Appendix D:
Mathematics Autobiography Protocol

1. Identify and write about significant moment you have had with mathematics from kindergarten to your current grade. Include pleasant and unpleasant moments. These moments can be in-school or out-of-school moments.
    a. Was there a point in time when you were drawn to mathematics?
        i. If so, when?
        ii. What attracted you to mathematics?
    b. Was there a point when you withdrew from mathematics?
        i. If so, when?
        ii. What do you feel caused you to withdraw from math?
2. When did you first realize that you were "good/not good at math?"
    a. Describe and elaborate on this memory.
    b. How did you feel when you realized that you were "good/not good at math?"
    c. Who helped you realize that you were "good/not good at math?" How?
3. Describe the best math teachers you had.
    a. What was it like to learn from this teacher?
    b. How was this teacher different from other teachers?

Appendix E:
Revised Social Knowledge Structure



Appendix F:
Math Log

Date	Incident/Experience	Math Connection	Math Concept(s)
	What happened…	What I thought about/What I had to do…	What types of math (algebra)/ What topics (ratios, areas)
October 2	Grocery store visit	Determining better or best buy	Ratios and proportions

Appendix G:
Student Participant Demographics

Participant[1]*	Gender	Age	Grade	School Type	
				2012-2013	2013-2014
Gabourey	F	12	7	Independent	Independent
Omari	M	13	8	Public	Public
Aminah	F	13	9	Public	Public
Tyson	M	14	9	Independent	Public
Bryan	M	14	9	Independent	Public
Tamar	F	14	9	Public	Public

[1] Pseudonym.

Appendix H:
Student Interview Guides

H1: Student Interview Guide 1

Pseudonym___________________________________

Code____________________________

Interview Type ____________________ Location: _______________________

In Person___________ Interview Date: ___________________

Phone ___________ Interviewed By:___________________

Where Stored/Filename

Voice Recording: ____

1. What do you think about when I say "mathematics"?
2. Describe any students who you believe are good mathematics students.
3. How much do you enjoy mathematics?
4. Describe a time/class/setting when you enjoyed mathematics.
5. How do you know that they are good mathematics students?
6. What does a student have to do to be good at mathematics?
7. How do you like math this year?
8. How does it compare to last year? Before then?
9. Compared to most of your other school subjects, how good are you in math?
10. Some things that you learn in school help you do things better outside of class, that is, they are useful. For example, learning about plants might help you grow a garden. In general, how useful is what you learn in math?

11. Are there any students who just aren't smart enough to be good at math, or can every student learn math if they try hard enough? (Don't ask for names.)
12. Why do you think there are some students who can't do very well in math? (Or how do you know everyone can learn math?)
13. What are some of your favorite mathematical activities that you have done?
14. What kinds of things have your best math teachers done to help you learn math?
15. Do you think that it is important to learn math? Why/Why not?
16. Compared to most of your activities, how important is it for you to be *good* at math?
17. How good would you be at learning something new in math?
18. Do you agree/disagree with the following statement:
    To do well in mathematics, you need natural talent.
19. Do you agree/disagree with the following statement:
    To do well in mathematics, you need hard work.
20. Do you agree/disagree with the following statement:
    To do well in mathematics, you need to memorize notes.
21. Do you agree/disagree with the following statement:
    To do well in mathematics, you need to look at the textbook.

H2: Student Interview Guide 2

Pseudonym_____________________________________

Code_____________________________

Interview Type _____________________ Location: ________________________

In Person___________ Interview Date: ___________________

Phone ___________ Interviewed By:___________________

Where Stored/Filename

Voice Recording: ____

1. What do you think your friends think of you as a mathematics student?
    a. Are most of your friends on the same math track as you are in school?
    b. Do your friends encourage you to do well in mathematics?
2. What role do your parents/guardians play in your mathematics learning?
3. Do you have a person other than your parents/guardians or your current math teacher who monitors your mathematics progress? If so, who and how?
4. Who helps you when you are having trouble in mathematics? How?
5. Did you have a person who inspired you to do well in mathematics?

H3: Student Interview Guide 3

Pseudonym_________________________________

Code_______________________________

Interview Type ______________________ Location: _________________________

In Person___________ Interview Date: ____________________

Phone ___________ Interviewed By:____________________

Where Stored/Filename

Voice Recording: ____

1. What expectation do you have of yourself in mathematics?
2. How do you see African Americans doing in mathematics?
3. What lessons can other African American students learn from you to help them do well in mathematics?
4. Do you believe that being an African American affected your school and/or mathematical experiences? Why or why not? How?
5. What is it like being an African American (fe)male at your school?

Appendix I:
Final Code Key

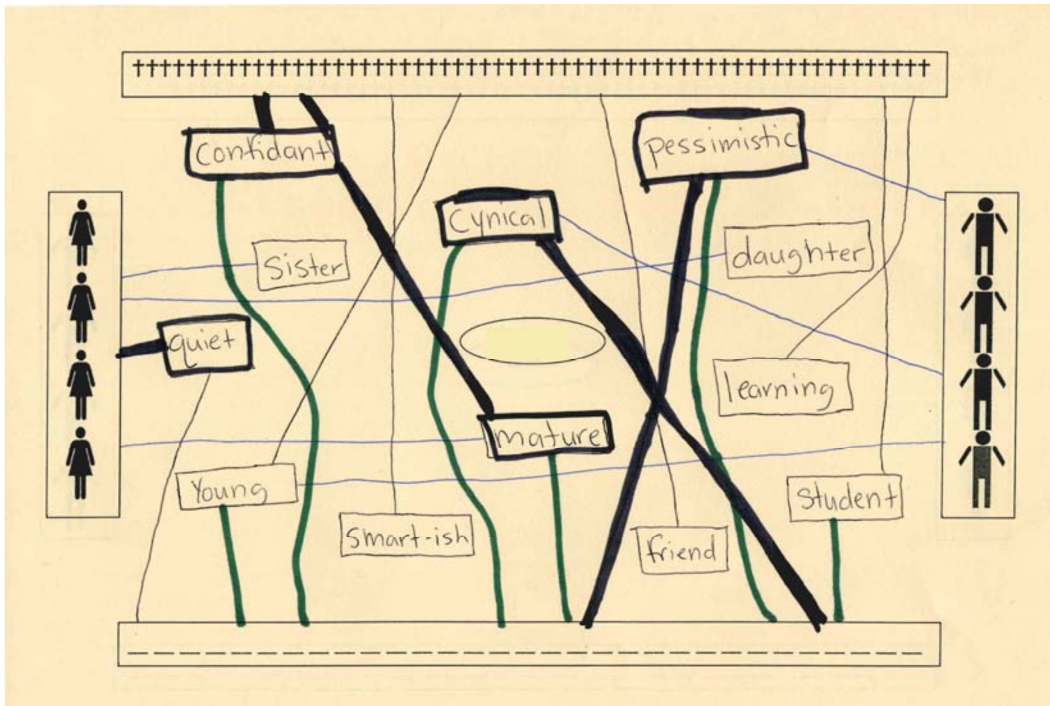
Code	Definition/Meaning	Criteria
DefoMat	Definition(s)/Characterization(s) of Mathematics	1. Student describes their ideas of what math is/means 2. Student reveals their description of mathematics or math content
PersAble	Self-Descriptions/Characterization of Personal Ability	1. Student recognizes, characterizes, assesses, or evaluates *his/her own* ability. 2. Student assess potential for success in math
LearnAssess	Assessment of learning	Student assesses or considers learning of *others*
PleasurEx	Description of a Pleasant/FavorableMath Experience or Activity	Describes pleasant math experience/memory
Concess	Concept of Math Success/Competence	1. Student describes their criteria for being a good/competent math student 2. Student describes conditions for success in math 3. Student describes student attributes that facilitate math competence
CNFDN	Confidence	Discusses confidence/lack of confidence in mathematical or academic ability
EXPCT	Expectations	Student shares expectations about own mathematics achievement/ performance
HIST	Mathematical history	Student or parent shares math history
FamIn	Family Influence	Student shares information about other family member
UTIL	Utility of Mathematics	Student talks about the GENERAL usefulness of math
APPL	Applicability of Mathematics	Student talks about applying math in personal life
UBIQ	Ubiquity of Mathematics	Math is everywhere
IMP	Importance of Mathematics	Student discusses the importance of math
AGENC	Personal Agency	Student describes incident of agency, authority, or autonomy
SOCOMP	Social Comparison; Social Others; BUT DISTINCT FROM FAMILY Classmates	1. Student makes a comparison of self to others; or others to others 2. Student includes other students' perceptions of them
AFF	Liking/Not Liking Enjoying/Not Enjoying Math or Math Experience(s)	1. Student describes level of enjoyment of math 2. Student includes statement of emotions, feelings as they relate to math experiences
CARE	Caring	Student describes teacher/significant other caring about them and/or other students

UND	Reference to Understanding math, math concepts	Student refers to understanding math concepts; importance of knowing with understanding
TCHR	Reference to Teacher(s)	1. Describes helpful/nonhelpful teacher actions, behavior, or displayed/inferred attitude 2. Describes specific feedback from particular teachers
CLMT	Climate	Student describes classroom or school climate/environment/interactions
EFF	Effort	Student describes effort to do or learn math, math activity
NTRST	Interest	Student addresses topic of interest/motivation in math
STRGL	Struggles; Difficulties with mathematics	1. Student discusses math as difficult, frustrating, or confusing 2. Discusses subject of math or math class(es) as being challenging
DSCPL	Discipline and Classroom Management	Teacher, school, system discipline concerns articulated
CLASSPRCT	Classroom Practice, Procedure, Routine	Student describes classroom practice, procedure, or routine
PREP	Career/College [Educational] Preparation	1. Student refers to career aspirations/ opportunities, college (or course) preparedness 2. Student refers to actions taken/to be taken to strengthen math ability/performance
GNDR	Gender Ascription	Student discusses gender attributes
MNRTY	Minority status	1. Student describes incident of personal recognition of racial salience 2. Student perceives/feels made to perceive minority status
AAf	African Americans	Student shares thoughts about African Americans in general, without reference to specific, personal experience
STEREO	Stereotypes	1. Student refers to racial or gender stereotype 2. This does NOT describe *countering* a stereotype
AntiTYP	Counter Stereotypes	1. Student rejects racial or gender stereotype 2. Student shares personal experience or thoughts that counter what they believe to be prevalent stereotypes they feel may be applied to self

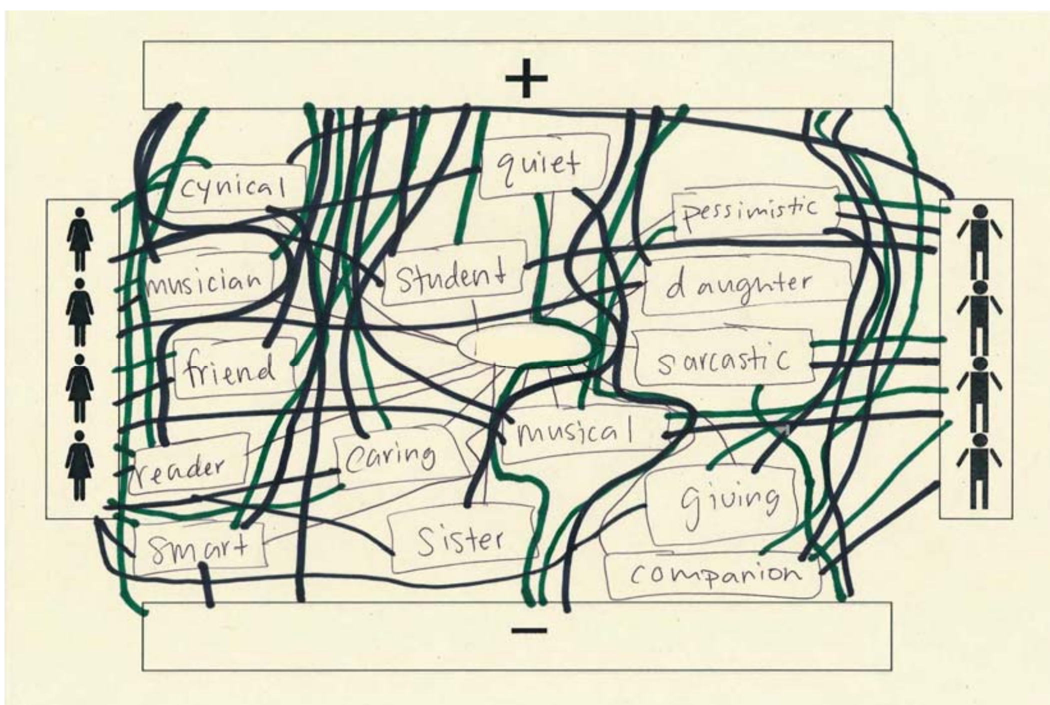
Appendix J:
Participant Social Knowledge Structures

Each page contains two SKS graphics composed by the same participant, whose pseudonym appears in the central node. The SKS on the bottom of the page was composed one year after the one on the top of the page.

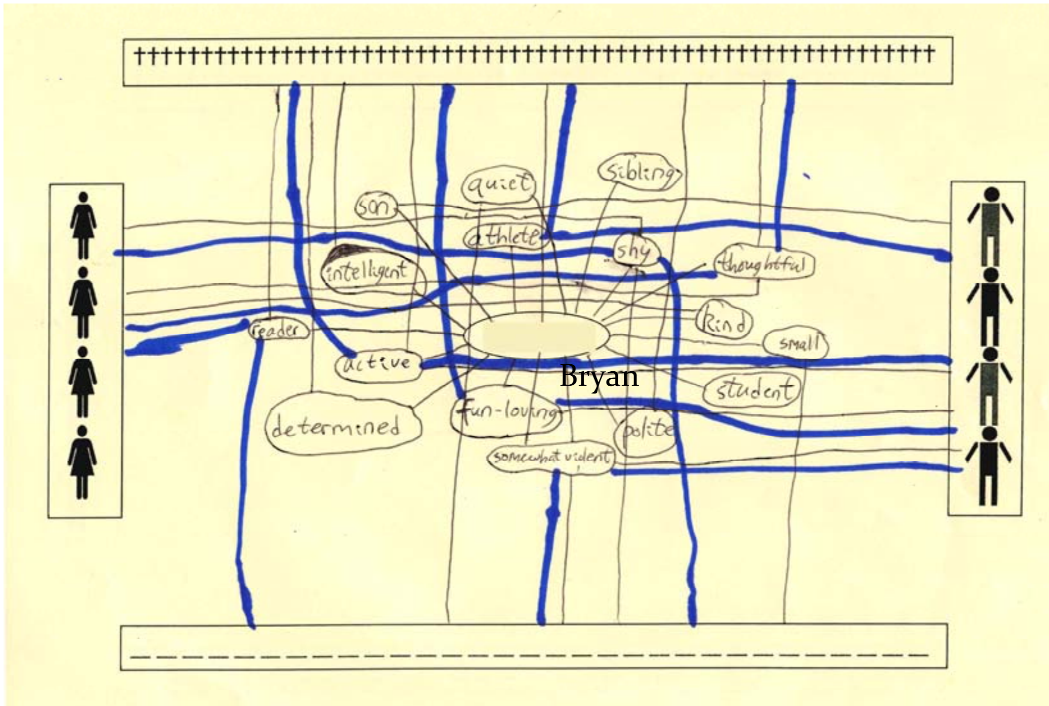
J1: Aminah's First SKS



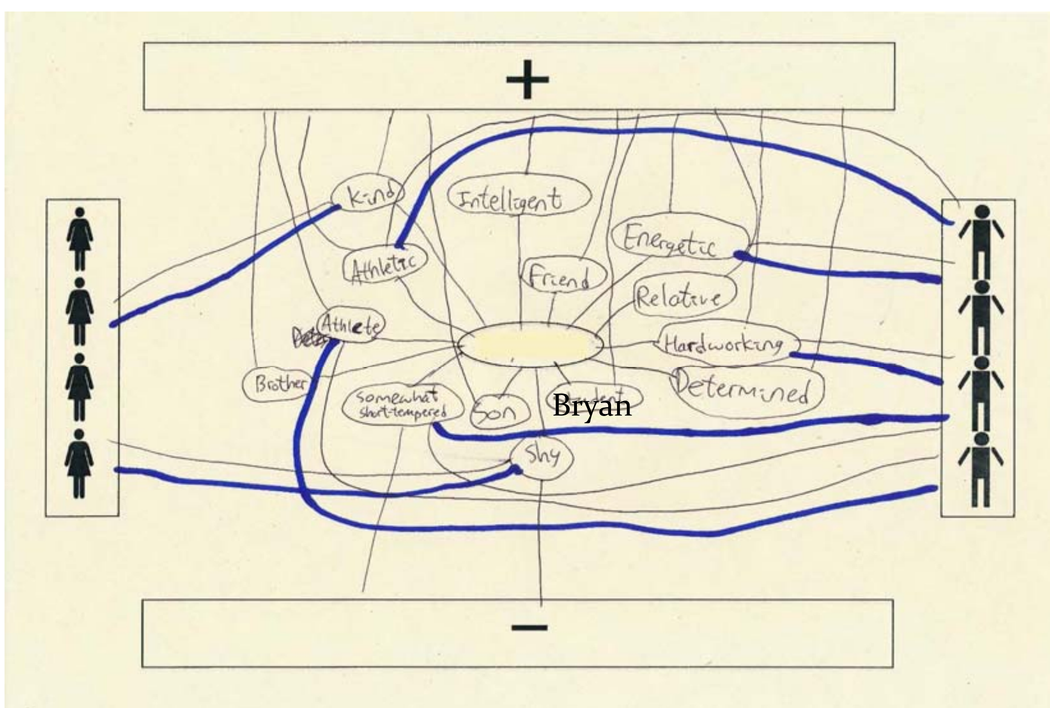
J2: Aminah's Second SKS



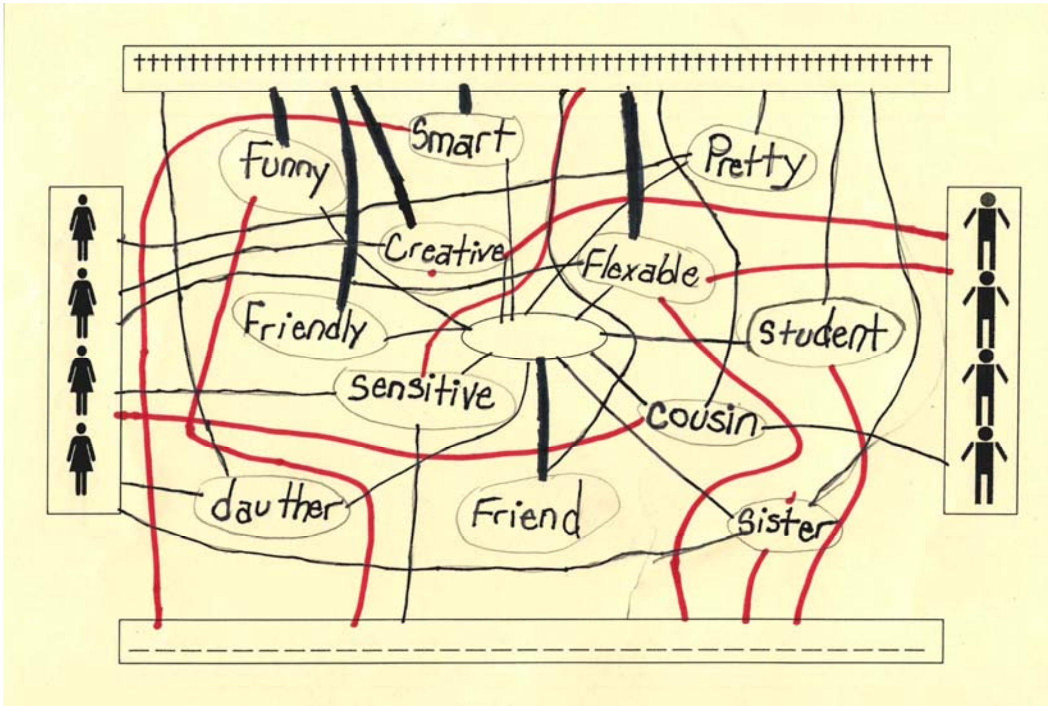
J3: Bryan's First SKS



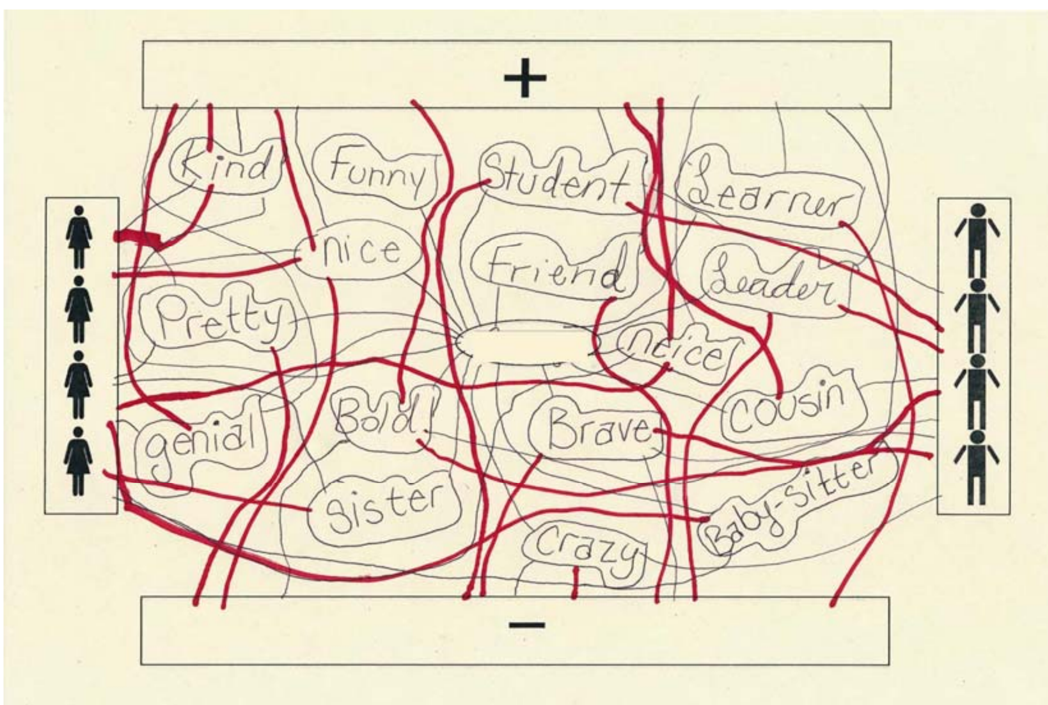
J4: Bryan's Second SKS



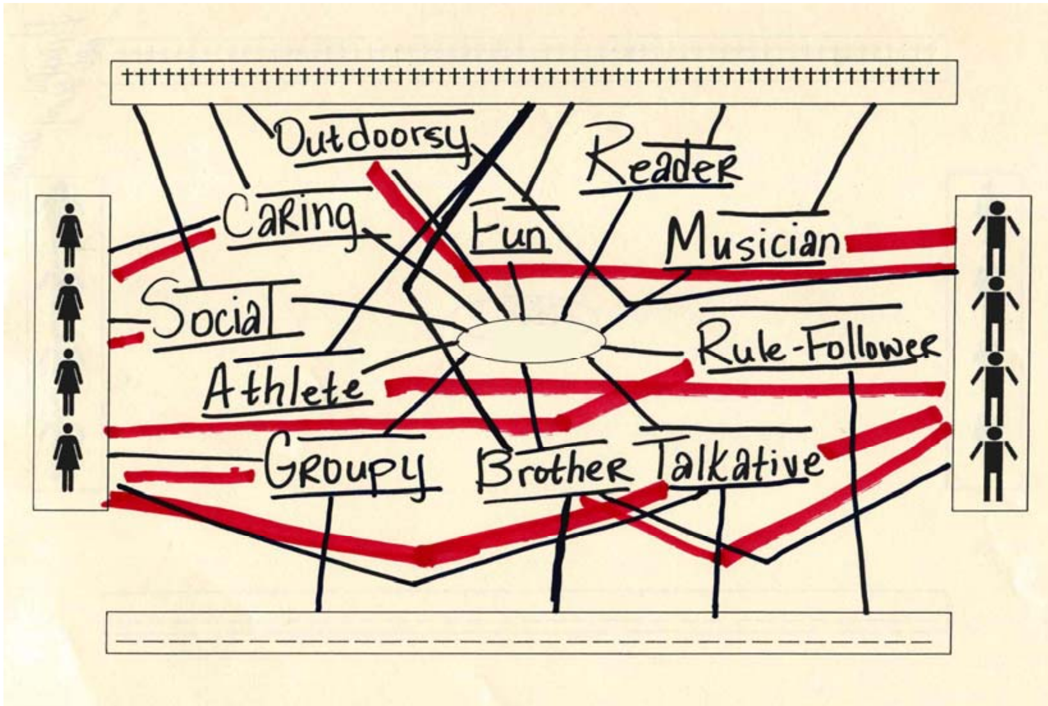
J5: Gabourey's First SKS



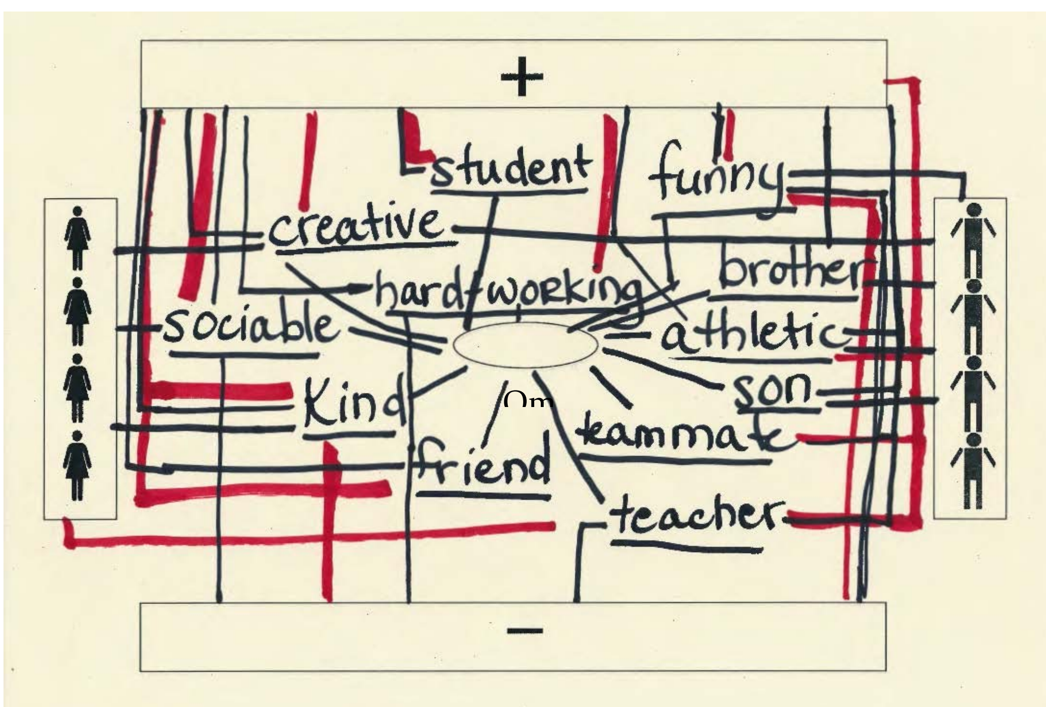
J6: Gabourey's Second SKS



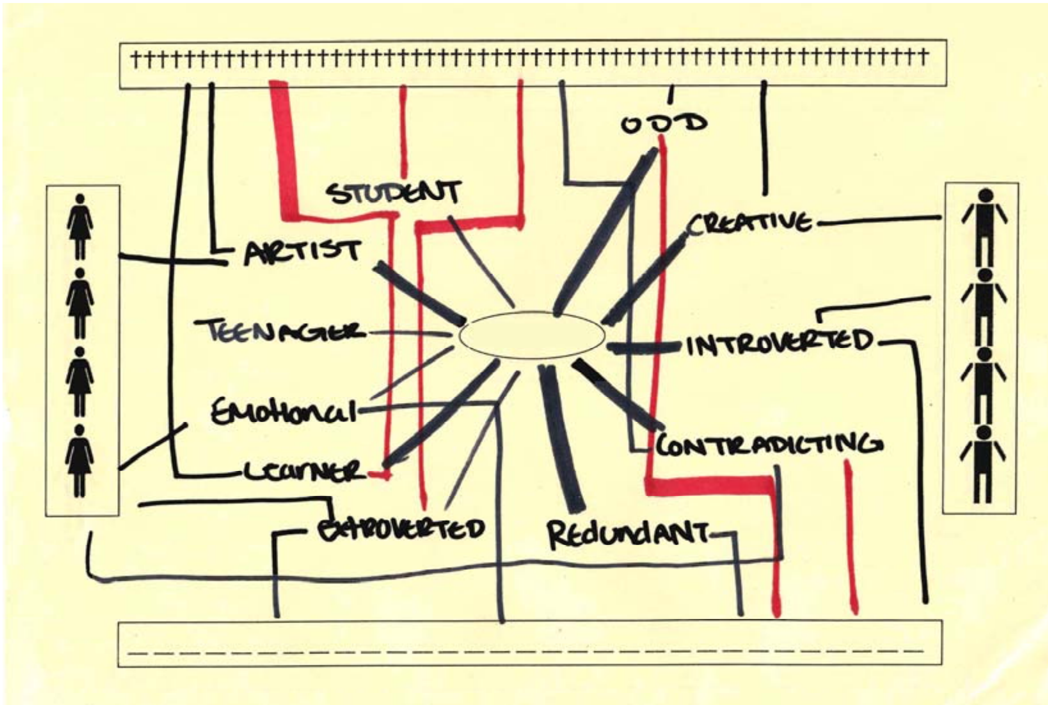
J7: Omari's First SKS



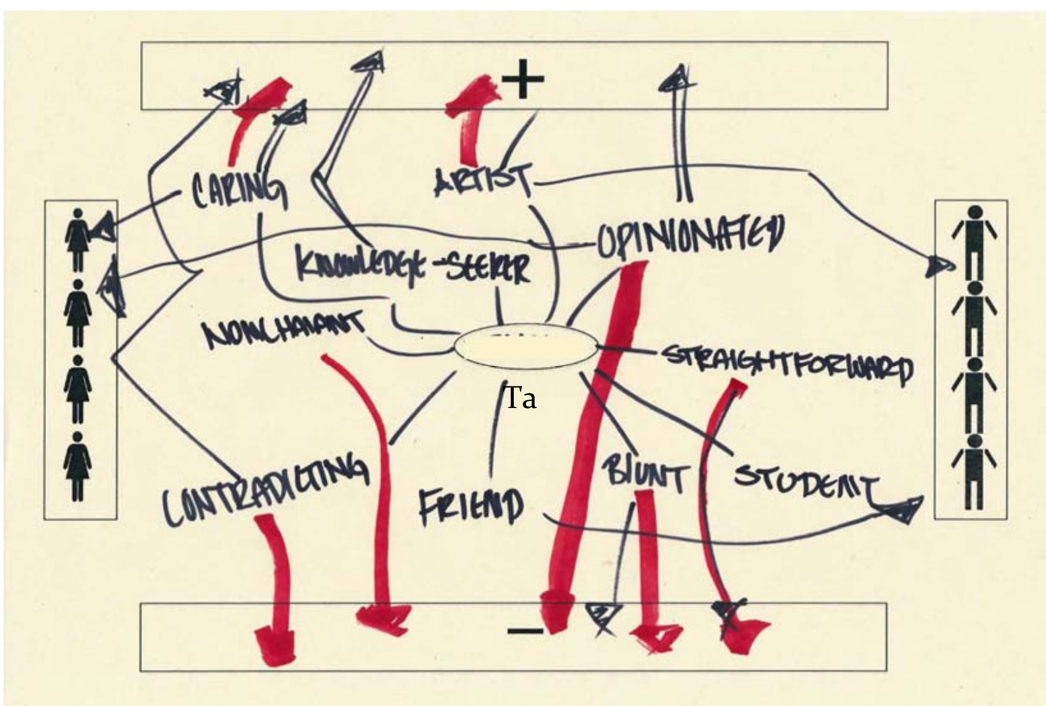
J8: Omari's Second SKS



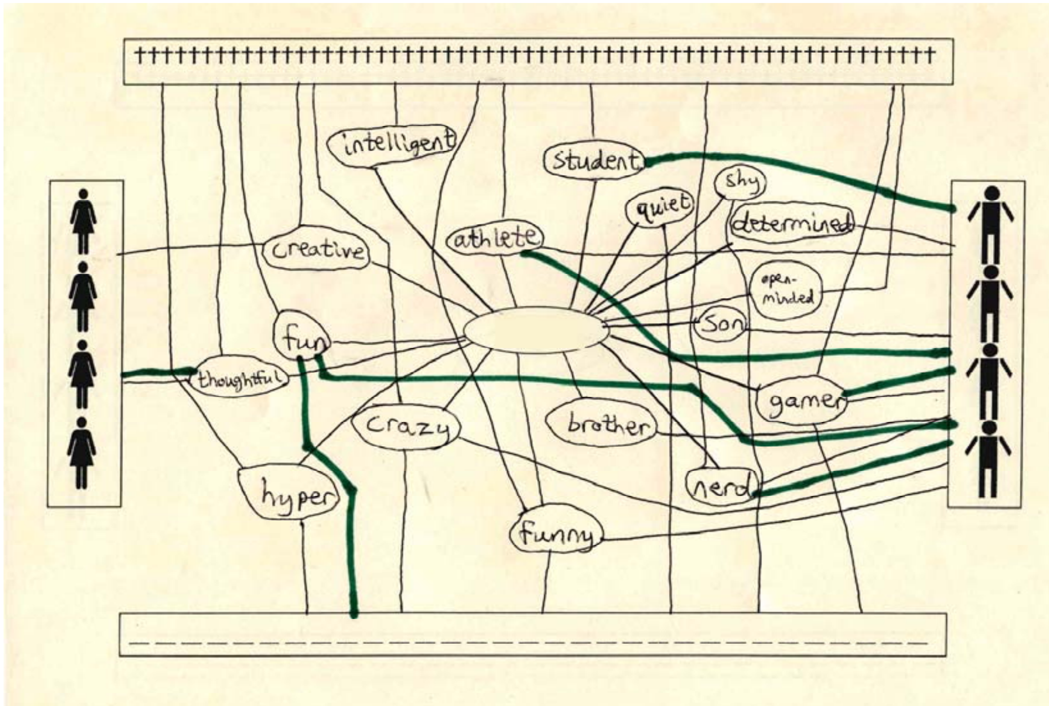
J9: Tamar's First SKS



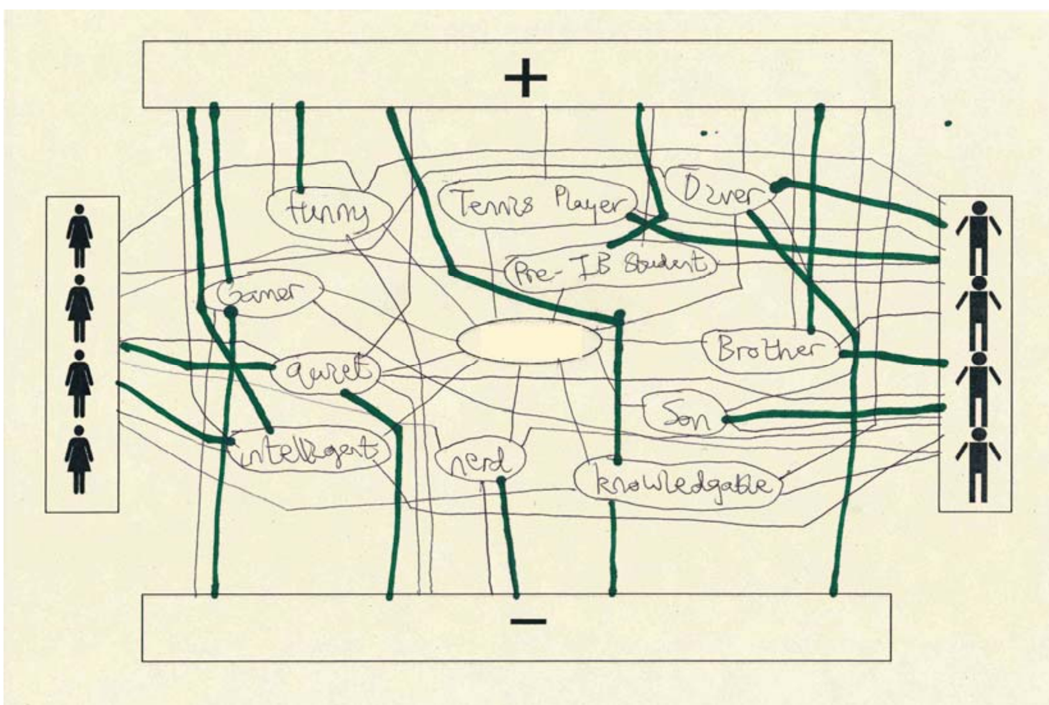
J10: Tamar's Second SKS



J11: Tyson's First SKS



J12: Tyson's Second SKS



Appendix K:
Multidisciplinary Inventory of Black Identity-Teen (MIBI-t)†

(1)Really disagree. (2) Kind of Disagree. (3) Neutral. (4) Kind of Agree. (5) Really Agree

		Dimension	Aminah	Bryan	Gabourey	Omari	Tyson
1	I feel close to other people.	*Centrality*	4	5	5	5	4
2	I am happy that I am Black.	*Private Regard*	5	5	5	5	5
3	Most people think that Blacks are as *smart* as people of other races.	*Public Regard*	2	2	2	2	2
4	It is important that Blacks go to White schools, so that they can learn how to act around Whites	*Assimilation*	1	4	2	1	3
5	Being an individual is more important than identifying yourself as Black	*Humanist*	4	5	5	5	3
6	People of all minority groups should stick together and fight discrimination	*Minority*	4	5	5	5	4
7	Black parents should surround their children with Black art and Black books.	*Nationalist*	3	4	2	4	5
8	I have a strong sense of belonging to other Black people	*Centrality*	3	3	2	4	4
9	I am proud to be Black	*PrivateRegard*	5	5	5	5	5
10	People think that Blacks are as *good* as people from other races	*Public Regard*	2	4	2	2	3
11	I think it is important for Blacks not to act Black around White people	*Assimilation*	1	2	3	2	2

† No data for Tamar, who identified as "Asian."

12	Blacks should think of themselves as individuals, not as Blacks	*Humanist*	4	3	5	5	5
13	There are other people who experience discrimination similar to Blacks.	*Minority*	5	5	5	5	5
14	Whenever possible, Blacks should buy from Black businesses.	*Nationalist*	3	3	3	2	3
15	If I were to describe myself to someone, one of the first things that I would say is that I'm Black.	*Centrality*	2	2	1	2	5
16	I feel good about Black people.	*Private Regard*	3	5	3	5	4
17	People from other races think that Blacks have made important contributions.	*Public Regard*	4	1	5	4	5
18	Blacks should act more like Whites to be successful in this society.	*Assimilation*	1	4	2	1	1
19	Black people should not consider race when deciding what movies to go see.	*Humanist*	5	5	5	5	5
20	Blacks should spend less time focusing on how we differ from other minority groups and more time focusing on how we are similar to people from other minority groups.	*Minority*	3	5	5	5	4
21	Blacks should support Black entertainment by going to Black movies and watching Black TV shows.	*Nationalist*	3	4	1	4	3

Appendix L:
Participant Math Logs

L1: Aminah's Math Log

Math Log

Date	Incident/Experience What happened...	Math Connection What I thought about/ What I had to do...	Math Concept(s) What types of math (algebra)/ What topics (ratios, areas)
July 2	Grocery store visit	Determining better or best buy	Ratios and proportions
10.17.12	Band practice	counting the beats in a measure	
10.17.12	Grocery store visit	calculating the total	
10.23.12	figuring out how to →	division	
	march double time		
10.24.12	counting change	addition & subtraction	
10.27.12	calcuating the cost of a book w/ discount	percents	
11.7.12	figuring out factors of 8 ~~(multipli~~ (Band)	multiplication	
1.5.13	Finding number of pages to read in book	division	
1.5.13	putting bulletin boards up	measurement	
1.10.13	Counting how long my classes are	time / counting	

Aminah's Math Log (page 2)

1.13.13	counting days until the taylor swift concert	counting
1.18.13	dividing up the cost of a movie visit ?	division
1.22.13	counting the hours it took to make a jeopardy game	Counting /time
1.26.13	~~counting the~~ calculating the time I needed to leave Reading Bowl to get ~~to~~ Battle of the Bands	addition/ time
1.27.13	calculating price of movie/ Cutting cost	subtraction/ multiplication
1.3.13	counting how many times I saw Capernick during the superbowl	addition
1.9.13	Calculating how long it took my mom to do my hair	addition
1.12.13	counting notes for a clarinet solo (band)	addition/subtraction
1.16.13	counting how long a movie would last	addition

L2: Bryan's Math Log

Math Log

Date	Incident/Experience What happened…	Math Connection What I thought about/ What I had to do…	Math Concept(s) What types of math (algebra)/ What topics (ratios, areas)
July 2	Grocery store visit	Determining better or best buy	Ratios and proportions
July 8	Job prospects and profits	Determining which job gets me the greatest amount of money in short time	Graphs, functions
August 2	Getting school supplies	Determining better or best buy	Ratios and proportions
August 18	Trip to Target	Determining best gift to buy	Ratios and proportions
September 4	Looking at school schedule	Determining how to balance out my schedule for ex-curriculars	Ratios, time, logic
September [illegible]	Getting books for English	Getting the best value for certain books	ratios, values
October 20	Getting Halloween candy	Getting the best value and size for the candy	proportions, values
November 7	Looking at track schedule	Balancing out my track and my studies	time, ratios, logic
December 12	Getting gifts	Determining the best value for gifts	ratios, values
January 7	Looking at new schedule (school)	Determining how to balance out new schedule w/ ex-curriculars	time, ratios, logic
January 25	Looking at track meet schedule	Determining how track meets will interfere w/ my studies	time, ratios, logic

L3: Gabourey's Math Log

Math Log

Date	Incident/Experience What happened...	Math Connection What I thought about/ What I had to do...	Math Concept(s) What types of math (algebra)/ What topics (ratios, areas)
July 2	Grocery store visit	Determining better or best buy	Ratios and proportions
Sept 17	red light	The school speed limit	Proportion
Sept. 25	Grocery store	Which 36 own m-em x is the cheaps	Compare + Contrast
Sept. 24	outfits	how many skirts fit me	addtion + Subtraction
Oct. 1	met my mom talking about my drama club	We were trying to figure out what percent of people in my group memorized their script	Percentage + fractions
Oct. 2	Setting the table	how many people I needed to bring plates for	addition
Oct 3	Packing	how many pairs of each of my cloches do I need	addition
Oct 3	Driving	how many hours it takes to go to NC	addition multipcation
Oct 8	Pop Rocks	I had to think about how many pop rocks I had and how many family members I had	adding
Oct 6	festival in NC	had to decide what I could buy. (dress)	adding + subtracting
Oct 10	at lunch	see how many varites I had to choose from	addition

L4: Omari's Math Log

Math Log

Date	What I did	Math thoughts I had
July 4	Saw the fireworks show downtown for independence day celebration	*Force and Motion *Geometry/shapes
July 5	Watched the long ranger (movie) with friends	
July 6	Had a pool party	*trajectory of splashes compared to weight of person and how far their splash can go
July 7	Played nuttie fluffies game on my nook (roller coaster game)	*Trajectory (roller coaster car goes off of track *force and motion
July 8	Played Halo 4 (video game) with a friend	*the terminal velocity of a bullet in real life is still slower than the bullets in the real game (showing its unrealistic in a way)
July 9	Took shots on the soccer field with a friend	*tried to graph in my mind the easiest way to bend the ball into the goal
July 10	Argued about how much I never get the TV	*fractions (compared the one person's time to mine in a fraction hours of TV. over hours in the day
July 11	Left for a pool party an hour late	*calculated how long it would take to get to the party at 35 mph on average
July 12	Watched the movie Grown Ups 2	*(Geometry) Pondered how it is mathematically possible that a moose could fit through a small door a small as the one shown
July 13	Washeed the ice cream trucks	*tried to plan a clear route for the car to go between to trucks to jump start one using simple logic, knowing how fast the car moved, how much space I had, and how much space the car took up
July 14	Got to drive car around parking lot	*looked at the axils of the wheels and determined if it was possible for the car to turn as sharp as I needed
July 15	Driving home from Georgia to Virginia	*determined how long it would take to get to Florence using an average speed of 60 mph (to make it easier to do the math)

L5: Tamar's Math Log

Math Log

Date	Incident/Experience What happened…	Math Connection What I thought about/ What I had to do…	Math Concept(s) What types of math (algebra)/ What topics (ratios, areas)
July 2	Grocery store visit	Determining better or best buy	Ratios and proportions
16th/08	Walking to school	determine time to walk	estimating
16th/08	Cooking	determine how much s[illegible]	Fractions
23rd/08	sending a letter	determine how long to send letter	estimating
23rd/08	Sending letter	determine how much to put on letter	~ Not sure…
8th/08	painting	how much paint to use	porportions
28th/08	Storing away art supplies	how much space in a box	Algebra / Geometry
1st/09	Listening to music	how many songs on an hour	algebra
2nd/09	School grades	Average of tests in all	Average
3rd/09	School grades	Find out why I failed	[illegible] Percents
6th/09	Math	Find Slope	Linear equations

Minimum: Twice each week

Date	Incident/Experience What happened…	Math Connection What I thought about/ What I had to do…	Math Concept(s) What types of math (algebra)/ What topics (ratios, areas)
July 2	Grocery store visit	Determining better or best buy	Ratios and proportions
8th/09	Counting money	How much I spent	percent

L6: Tyson's Math Log

Math Log

Date	Incident/Experience What happened…	Math Connection What I thought about/ What I had to do…	Math Concept(s) What types of math (algebra)/ What topics (ratios, areas)
July 2	Grocery store visit	Determining better or best buy	Ratios and proportions
Aug 3	Walmart Shopping	determining tax	Multiplication, subtraction
Aug 16	Running to lunch	trying to get to line asap	Rate, distance, time
Sept 3	Playing indoor soccer	determining where and how hard to kick ball	Angles (Geo), Trig.
Sept 25	Finishing a test	Timing, finish tests asap	Time, rate
Oct 5	Allowance	Deciding how long I need to save up to buy gifts	Linear function, rate
Oct 12	Health Survey	Determining how many people per option	Ratios
Oct 31	Halloween	Trying to hit as many houses as possible w/ friend and brother	Distance, Rate, Time
Nov 26	Driving	Determining the amount of force needed when driving	Force, mass, Weight Distribution
Dec. 15	Deciding Xmas Gifts	Determining how many gifts to get	Ratios & Proportions
Aug 13-Now	Math Class	Powerpoints, tests, quizzes, etc.	Algebra, Geometry, Trigonometry

Appendix M:
Parent/Guardian Interview Protocol

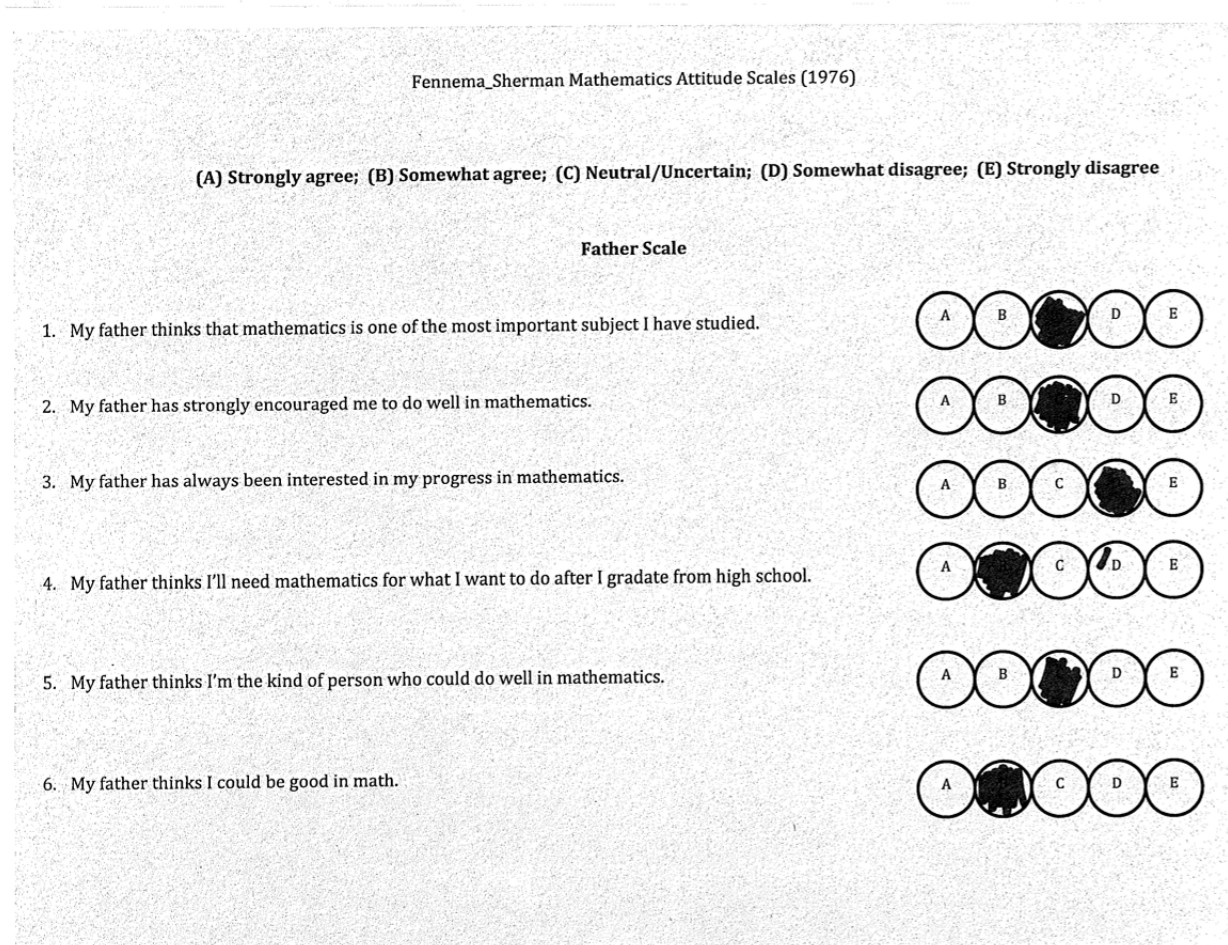
I am interested in learning about your child's mathematical experiences. You do not have to answer a question if you do not want to. I will assure your confidentiality. Neither your name, nor your child's, will appear in any presentation of data from this study. If you decide that you do not want to participate, just tell me. You can withdraw or discontinue your participation at any time without further obligation. The interview should take about 45 minutes to complete. May I ask you some questions now?

1. Describe *student's name* mathematical history.
    a. Are there any particular mathematical moments that stand out in your mind?
2. Describe *student's name* mathematical abilities.
3. Describe *student's name* mathematical performance in regards to his/her mathematical abilities.
    a. In your estimation, has *student's name* always performed up to his/her capabilities?
4. Describe placement in regards to his/her abilities.
    a. Has *student's name* always been placed in mathematics courses (groups) that match his/her abilities?
5. Describe any incident where you felt the need to be an advocate for your child as a student.
6. What should a person look for in a good mathematics teacher?
    a. Has *student's name* had good mathematics teachers?
7. What is your family's stance on support and help with schoolwork?
8. What do you believe about achievement?

9. How do you see your role in your child's education?
10. What kinds of things do you say to your child about mathematics?
11. Describe your own mathematical history.
    a. Were you good in mathematics?
        i. Do you ever tell that you were good/not good in mathematics? Why or why not?
12. What expectations do you have of *student's name* in mathematics?
13. How do you react when *student's name* does well in mathematics?
14. How do you react when *student's name* does not do as well as you would expect in mathematics?
15. Do you think that there are factors that African American (fe)male students must deal with that other students do not have to deal with in being a good student?
    a. If so, what are those factors?
    b. How do you help *student's name* deal with those factors?

Appendix N:
Tamar's Parent Scale Responses

N1: Tamar's Father Scale Responses



Fennema_Sherman Mathematics Attitude Scales (1976)

(A) Strongly agree; (B) Somewhat agree; (C) Neutral/Uncertain; (D) Somewhat disagree; (E) Strongly disagree

Father Scale

1. My father thinks that mathematics is one of the most important subject I have studied.
2. My father has strongly encouraged me to do well in mathematics.
3. My father has always been interested in my progress in mathematics.
4. My father thinks I'll need mathematics for what I want to do after I gradate from high school.
5. My father thinks I'm the kind of person who could do well in mathematics.
6. My father thinks I could be good in math.

Fennema_Sherman Mathematics Attitude Scales (1976)

7. My father wouldn't encourage me to plan a career which involves math.

8. My father hates to do math.

9. As long as I have passed, my father hasn't cared how I have done in math.

10. My father thinks advanced math is a waste of time for me.

11. My father thinks I need to know just a minimum amount of math.

12. My father has shown no interest in whether or not I take more math courses.

(A) Strongly agree; (B) Somewhat agree; (C) Neutral/Uncertain; (D) Somewhat disagree; (E) Strongly disagree

N2: Tamar's Mother Scale Responses

Fennema_Sherman Mathematics Attitude Scales (1976)

(A) Strongly agree; (B) Somewhat agree; (C) Neutral/Uncertain; (D) Somewhat disagree; (E) Strongly disagree

Mother Scale

	A	B	C	D	E
1. My mother thinks I'm the kind of person who could do well in mathematics.	●	B	C	D	●
2. My mother thinks I could be good in math.	A	●	C	D	E
3. My mother has always been interested in my progress in mathematics.	A	●	C	D	E
4. My mother has strongly encouraged me to do well in mathematics.	A	●	C	D	E
5. My mother thinks that mathematics is one of the most important subjects I have studied.	A	●	C	D	E
6. My mother thinks I'll need mathematics for what I want to do after I graduate from high school.	A	B	●	D	E
7. My mother thinks advanced math is a waste of time for me.	A	B	C	●	E
8. As long as I have passed, my mother hasn't cared how I have done in math.	A	●	C	D	E

Fennema_Sherman Mathematics Attitude Scales (1976)

(A) Strongly agree; (B) Somewhat agree; (C) Neutral/Uncertain; (D) Somewhat disagree; (E) Strongly disagree

9. My mother wouldn't encourage me to plan a career which involves math.

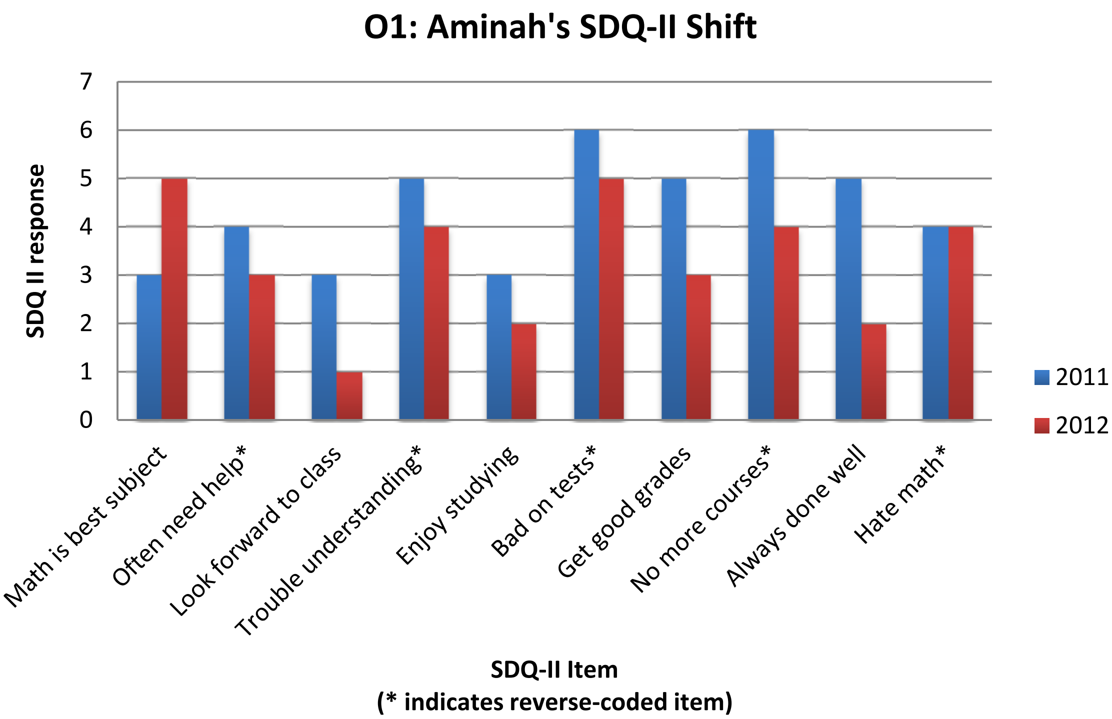
10. My mother has shown no interest in whether or not I take more math courses.

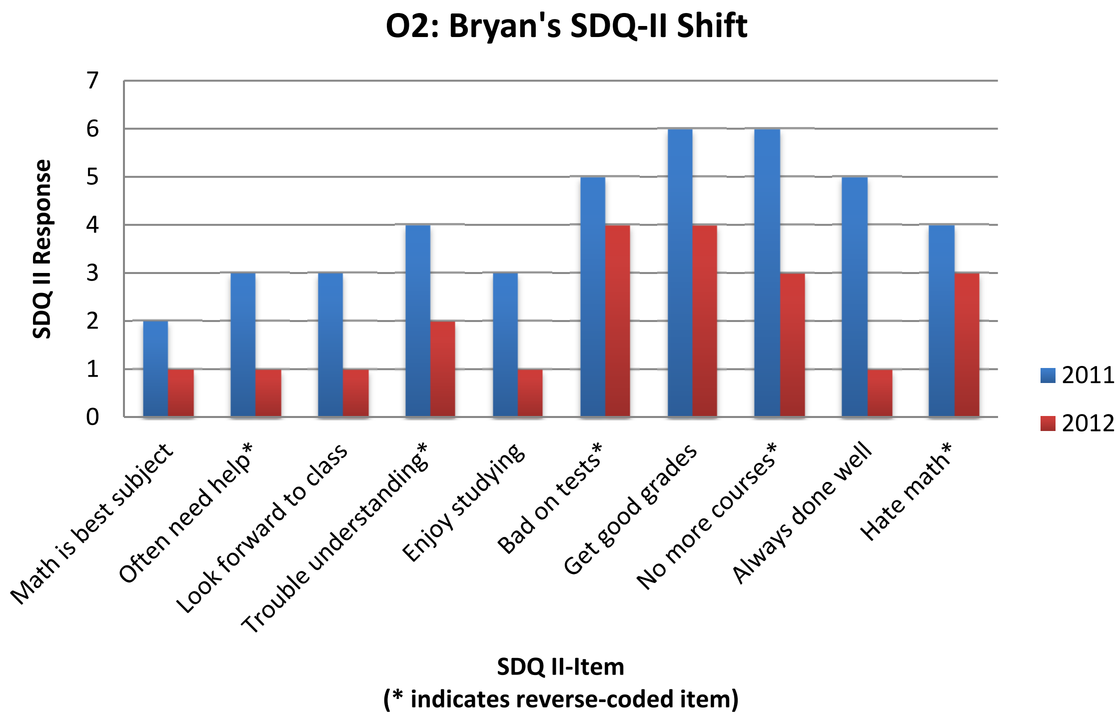
11. My mother thinks I need to know just a minimum amount of math.

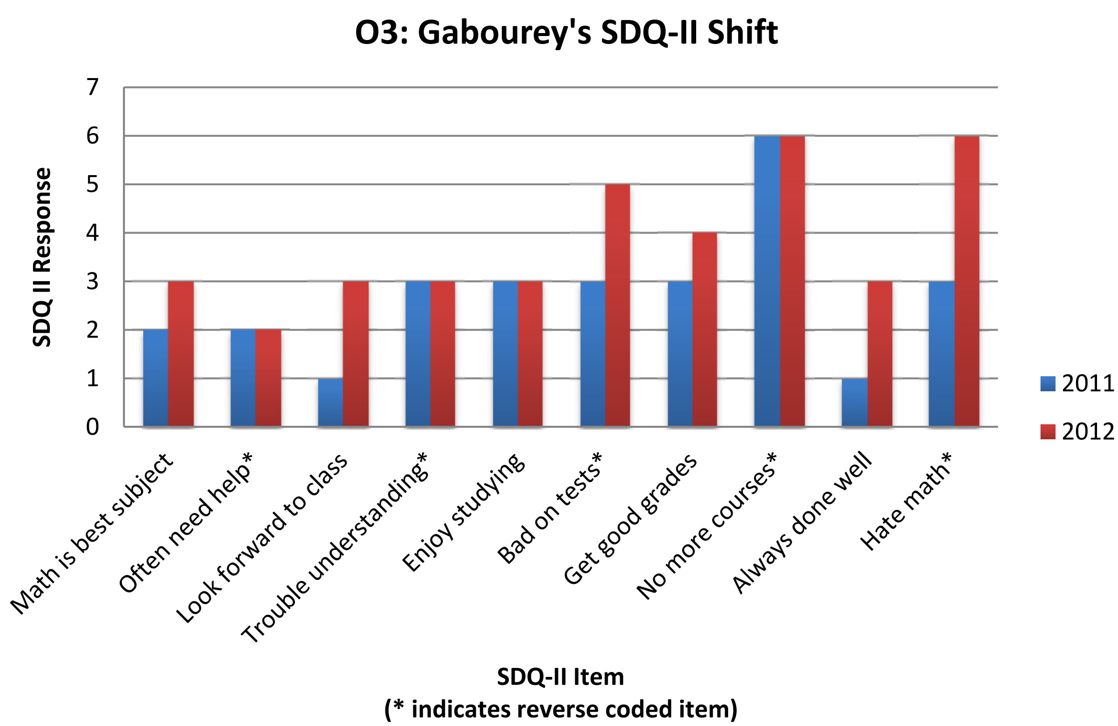
12. My mother hates to do math.

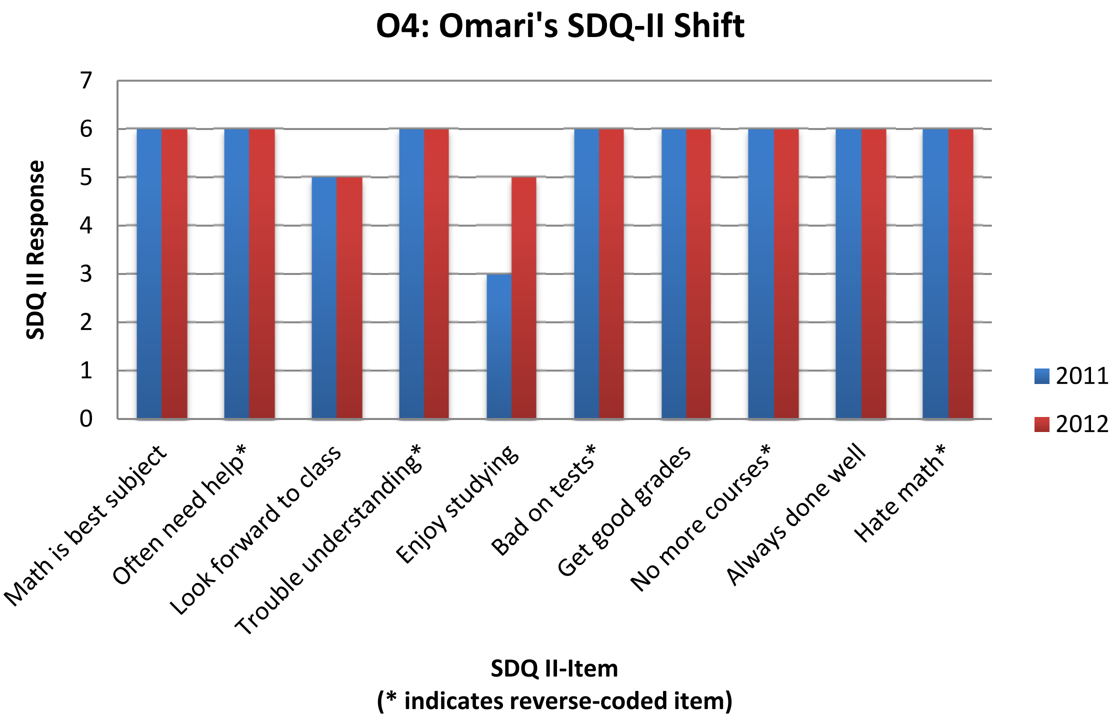
Appendix O:
Participant SDQ-II Shifts 2011-2012

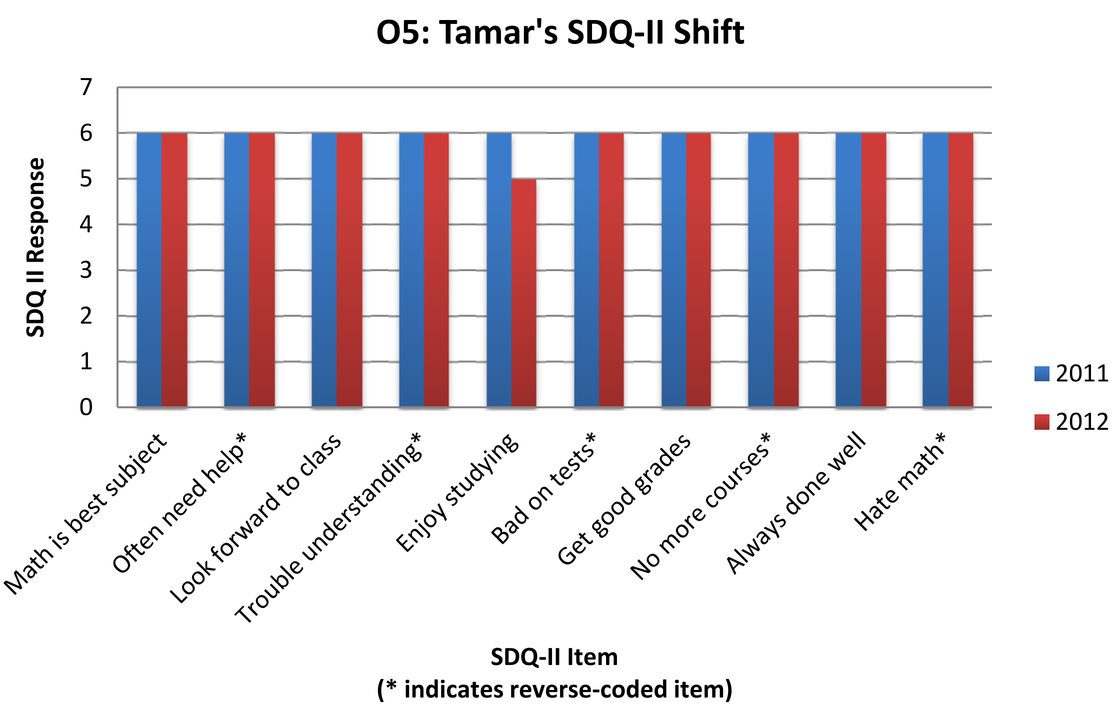
Some items (indicated with asterisk) have been reverse coded. These data are graphically displayed such that higher representations on these reverse-coded items reflect more positive mathematics self-concept beliefs.

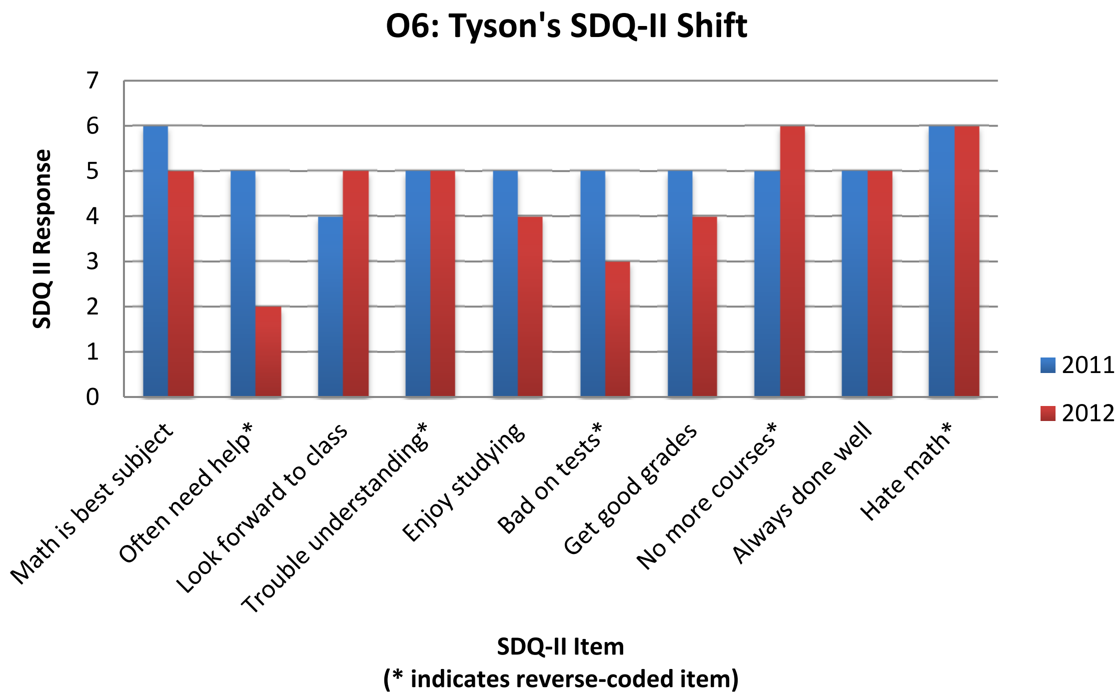



O2: Bryan's SDQ-II Shift
SDQ II Response
7
6
5
4
3
2
1
0
Math is best subject
Often need help*
Look forward to class
Trouble understanding*
Enjoy studying
Bad on tests*
Get good grades
No more courses*
Always done well
Hate math*
2011
2012
SDQ II-Item
(* indicates reverse-coded item)


O3: Gabourey's SDQ-II Shift
SDQ II Response
7
6
5
4
3
2
1
0
Math is best subject
Often need help*
Look forward to class
Trouble understanding*
Enjoy studying
Bad on tests*
Get good grades
No more courses*
Always done well
Hate math*
2011
2012
SDQ-II Item
(* indicates reverse coded item)


O4: Omari's SDQ-II Shift
SDQ II Response
7
6
5
4
3
2
1
0
Math is best subject
Often need help*
Look forward to class
Trouble understanding*
Enjoy studying
Bad on tests*
Get good grades
No more courses*
Always done well
Hate math*
2011
2012
SDQ II-Item
(* indicates reverse-coded item)


O5: Tamar's SDQ-II Shift
SDQ II Response
7
6
5
4
3
2
1
0
Math is best subject
Often need help*
Look forward to class
Trouble understanding*
Enjoy studying
Bad on tests*
Get good grades
No more courses*
Always done well
Hate math*
2011
2012
SDQ-II Item
(* indicates reverse-coded item)



O6: Tyson's SDQ-II Shift
SDQ II Response
0
1
2
3
4
5
6
7
Math is best subject
Often need help*
Look forward to class
Trouble understanding*
Enjoy studying
Bad on tests*
Get good grades
No more courses*
Always done well
Hate math*
2011
2012
SDQ-II Item
(* indicates reverse-coded item)

Appendix P:
Participant Responses to Mathematics as a Male Domain Scale

A: Strongly Agree ⟷ **E: Strongly Disagree**

		Aminah	**Bryan**	**Gabourey**	**Omari**	**Tamar**	**Tyson**
1	Females are as good as males in geometry.	A	A	A	A	A	A
2	Studying mathematics is just as appropriate for women as for men.	A	A	A	A	A	A
3	I could trust a woman just as much as a man to figure out calculations.	A	A	A	A	C	A
4	Girls can do just as well as boys in mathematics.	A	A	A	A	A	A
5	Males are NOT naturally better than females in mathematics	A	A	C	E	B	B
6	Women certainly are logical enough to do well in mathematics.	B	A	A	A	B	B
7	It's hard to believe a female could be a genius in mathematics.	E	E	E	E	C	D
8	When a woman has to solve a math problem, it is feminine to ask a man for help.	E	E	E	E	D	C

9	I would have more faith in the answer for a math problem solved by a man than by a woman.	E	E	E	E	C	C
10	Girls who enjoy studying math are a bit peculiar.	E	E	D	E	C	C
11	Mathematics is for men; Arithmetic is for women.	E	D	E	E	C	D
12	I would expect a woman mathematician to be a masculine type of person	E	E	E	D	C	E

Appendix Q:
Participant Responses to Attitude Toward Success in Mathematics Scale

A: Strongly Agree ⟷ **E: Strongly Disagree**

		Aminah	Bryan	Gabourey	Omari	Tamar	Tyson
1	It would make me happy to be *recognized* as an excellent student in mathematics.	C	A	C	A	C	A
2	I'd be proud to be the outstanding student in math.	C	A	B	A	D	A
3	I'd be happy to get top grades in mathematics.	A	A	A	A	D	B
4	It would be really great to win a prize in mathematics.	C	A	A	A	D	B
5	Being first in a mathematics competition would make me pleased.	C	A	C	A	D	A
6	Being regarded as smart in mathematics would be a great thing.	A	A	B	A	C	A
7	Winning a prize in mathematics would make me feel unpleasantly *conspicuous*.	B	E	E	E	C	C

8	People would think I was some kind of a *grind* if I got A's in math.	E	B	E	E	D	D
9	If I had good grades in math, I would try to hide it.	E	E	E	E	E	D
10	If I got the highest grade in math I'd prefer no one knew.	B	E	E	E	E	D
11	It would make people like me less if I were a really good math student.	E	D	E	E	E	D
12	I don't like people to think I'm smart in math.	C	D	E	E	C	E