MATHEMATICS CONFIDENCE IN AN URBAN HIGH SCHOOL:

BLACK STUDENTS' PERCEPTION OF MATHEMATICS EDUCATION

A Dissertation
Submitted to
The Temple University Graduate Board

In Partial Fulfillment
Of the Requirements for the degree
DOCTOR OF PHILOSOPHY

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by
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May 2017

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ABSTRACT

This was an investigation of students' mathematics confidence and how it is shaped by their accumulated experiences in mathematics education, and informs their view of the purpose of mathematics in their current and envisioned lives. There is no shortage of studies on black students' poor performance in mathematics education and its seeming persistence in spite of reform initiatives and policy changes. Conversely, there is a dearth of studies in the field on high achieving black students and the construction of their mathematics identities. Some scholars have argued that the plenitude of data on the failure of black students in mathematics education has contributed to mainstream beliefs of a *racial hierarchy of mathematics ability* in America. This perception has not only shaped attitudes and behaviors of educational scholars, policymakers, practitioners, but it has contributed to the alienation of many students from the community of "doers of mathematics." In an effort to combat the pervasiveness of race-based beliefs of math ability, some researchers in the field of mathematics have advocated for the need to refocus research on better understanding students' mathematics identity and its relationship to their performance. In light of this, this study, using ethnographic methods, examined the mathematics confidence—a subset of mathematics identity—of a group of seniors enrolled in honor's pre-calculus at an under resourced urban comprehensive high school. Data collected and analyzed for this study showed that participants, in spite of a history of mostly success in math and despite being socialized to view the classroom as opportunity to challenge disparaging views of African Americans, refused to seek or claim membership to the community of math people.

This study provides new insights into black students' perception of and sense of belongingness to mathematics, and its potential impact on their academic and economic prospects.

DEDICATION

This project is dedicated to my wife Rachel. This journey would never have made it past a dream, and bar stools banter without her unconditional love, support, patience, and unyielding commitment to a more equitable tomorrow. I would be remiss if I did not take this opportunity to also thank her for the countless feedback and always constructive criticism. Thank You. I love you.

ACKNOWLEDGEMENTS

Firstly, I need to acknowledge another very special person in my life, my mother, Marie B. Bonhomette. Words can only betray the depth of my gratitude for the sacrifices, the love, and boundless caring. Still, I thank you for the human you have allowed and challenged me to become.

I also want to acknowledge others who have knowingly or unwittingly helped me on this journey. I extend my deepest gratitude to the faculty members of the Brooklyn College's Africana Studies and Political Studies Departments—a special thank you to Dr. George Cunnhingham—who introduced me to the world of academia. To the City College of New York's Graduate English and Mathematics departments, thank you for fueling the fire under my love for words, the performing arts, teaching, and mathematics.

Finally, I want to thank the Temple University's Urban Education and Teaching and Learning Departments. Special thanks to Dr. Will J. Jordan who has been integral to my academic development and emerging identity as a researcher. I am grateful for Drs. Maia Cucchiara, Carol Brandt, and Kristie Newton for the research assistantship opportunities that have undoubtedly provided me the skills and confidence needed to complete this project. Lastly, many thanks to Dr. Michael Smith and the Teaching and Learning department for the support that have made it possible for me to devote the time necessary to complete this project.

This would not be possible without the students and teaching staff who agreed to be part of this study. Thank you for your time and for making me a part your community.

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CHAPTER 1

INTRODUCTION

The state of public schools in urban districts beset with issues like unemployment, concentration of poverty, crime, racial and social isolation has been the focus of educational researchers, policymakers and other stakeholders since Coleman et al.'s (1966) famous *Equality of Educational Opportunity*. In what is commonly known as the *Coleman Report*, a study of 4,000 schools across the U.S., the authors found that "when socioeconomic factors…are statistically controlled…differences between schools account for a very small fraction of differences in pupil achievement" (pp. 21-22). Many other studies since then have also underscored the crippling impact of socioeconomic forces such as poverty on public schools' performance, students and the overall communities those public institutions serve. Others have attributed the concentration of poverty in urban communities and its debilitating effect on urban school districts to the continued decline of inner-cities "in importance as economic, political, and commercial centers" since World War II (Noguera, 2003, p. 23; see also Anyon, 1997; Sharkey 2013; Wilson, 2009). This has caused many, Noguera (2003) remarked, to view ameliorating the condition of historically under resourced inner city schools as a "task…simply too big, too complex and too intractable" (p. xi).

This is particularly evident in the field of mathematics education where most studies concerned with social and racial achievement gaps have ranked black students from socioeconomically disadvantaged communities "in the lowest tails of academic achievements" (Tate & Rousseau, 2002, p. 210). A trend that the authors argued "does not appear to change in

any meaningful fashion" in spite of the numerous reform initiatives in the field (e.g., NCTM, 1989; NCTM, 2000). In fact, black students compared to their white middle-class counterparts have been disproportionally underrepresented enrolling in and completing advanced high school mathematics classes (National Center of Education and Statistics, 2004).

Some of the reasons for the persistence of this trend are evidenced in Oakes, Ormseth, Bell and Camp's (1990) national survey of the state of mathematics and science education in the U.S. They found that low-income black and Latino students when in the majority at a given public secondary school tend to "have less-extensive and less-demanding science and mathematics programs available to them" (p. 9). This is true even for high-ability racial minority students in under resourced and racially segregated schools who, compared to low-ability students in better resourced school districts, often have fewer opportunities to be enrolled in "the critical gatekeeping courses" necessary for post-secondary education (pp. 9-10). A possible explanation for this is delineated in Anyon's (1997) *Ghetto Schooling: A Political Economy of Urban Educational Reform* where she observed that the overwhelming majority of students that attend the school district of Newark are black and Latino and that only about half of their science and math teachers were qualified to teach. This is compounded by in school policies or practices such as *tracking*—"the notion that students learn better when they are grouped with other students who are considered to be like them academically" (Oakes, 1985, p. 6). Many have argued that such in school practices contribute to the perpetuation of race-based segregation of students within certain academic domains like mathematics and the persistence of the under-

representation of black and Latino high-school students in advanced courses (e.g. Oakes, 1985, 1992; Oakes, Ormseth, Bell & Camp, 1990; Rachlin, 1988).

However, in the midst of mainstream beliefs about the complexity and intractability of the issues plaguing urban school districts in America, and their crippling effect on the academic performance of many black students living in those districts, there are urban schools who have been successful at reversing the seeming trend of academic failure for black students. Noguera (2008) observed that for about two dozen public schools in the state of California, "when the test score data…were disaggregated on the basis of race and gender, there was no evidence of an achievement gap" (p. 36). Similarly, many researchers have "recognized that among groups believed to be at high risk for developing particular difficulties, many individuals emerge unscathed by adversity" (Borman & Rachuba, 2001, p. 2; see also Garmezy, 1991; Rutter, 1987).

This is evidenced at Oxford high school, located in the northeast section of the district of Philadelphia, which, in spite of its years of a failing performance grade relative to the district (*School District of Philadelphia*, 2015), has about 60 juniors and seniors enrolled in honor's mathematics and English courses. Those students are living examples of the "resilient children" often described as being "actively engaged in schools…and maintain[ing] healthy expectations" in spite of the systemic and persistent failures of their institutions. (Borman & Rachuba, 2001, p. 2; see Finn & Rock, 1997).

Statement of Problem

Because nearly 30% of blacks in America still live in poverty (National Poverty Center, 2010), researchers and educators concerned with issues of inequity have begun to focus on the

relationship between performance in mathematics classroom and social mobility. For instance, Beane (1988), in her study chronicling the visible and subliminal barriers preventing some students to succeed in mathematics and science, characterized mathematics classrooms as "critical filters" that could potentially serve to keep certain students of color and girls out of future academic and economic opportunities (Beane, 1988; see Sells, 1973). Freitas (2008) observed that, for minority students, particularly those living in poverty-stricken communities, mathematics "plays a pivotal role in the social structuring" of their lives (p. 43; see Moses & Cobb, 2001). Similarly, Tate (1994) found that for socioeconomically disadvantaged minority students, "taking geometry halved the gap of [their] college attendance" compared to their white middle-class counterparts (p. 372; see Pelavin & Kane, 1990). More broadly, Catsambis and Beveridge (2001), in their report published by the *Center for Research on the Education of Students Placed At Risk* (CRESPAR), remarked that the "relationship between mathematics achievement and future academic success" was more pronounced and more evident for black students (p. 21). This means that failure for certain minority students to enroll and succeed in mathematics classes has the potential to greatly hinder their life chances. In other words, for the 30% of poor black students living in the U.S, success in mathematics classroom has come to symbolize the key out of the tentacles of poverty, and perhaps their only viable path to professional and economic opportunities.

Given the fact that black students' performance in mathematics classrooms has seen very little improvement since the Coleman Report (1966), and even after *A Nation At Risk* (1983), and that success in mathematics has come to signify "[participation] in our democratic

processes…and…career choice and advancement" (Reyes & Stanic, 1988, p. 26) , many have argued for the need of a critical examination of mathematics education as it relates to curriculum content, pedagogies and instructions for students, particularly racial minority students (e.g. Apple, 1978, 1990, 1992, 2000; Esmonde, 2014; Frankenstein, 1983, 1989; Freitas, 2008; Gower, 2015; Greer & Mukhopadhyay, 2003; Gutierrez, 1996, 2008; Martin, 2000, 2003, 2006, 2007, 2012; Martin & Davis, 2008; Martin, Gholson, & Leonard, 2010; McCoy, 2008; McGee & Martin, 2011; Reyes & Stanic, 1988; Tate, 1994; Tate & Rousseau, 2003).

Background on Mathematics Education

Traditionally, researchers and educators in the field of mathematics concerned with improving students' performance have been "on opposing sides" in the "roles of procedural and conceptual knowledge in students" mathematical learning and performance—this is often referred to as the "math wars" (Star, 2005, p. 4; see also Brownell 1945; Hiebert & Lefevre, 1986; Skemp, 1976; Sowder, 1998). It is best known as the divisive debate over 'traditional' versus 'reform' in mathematical standards, curricula and pedagogies. Star (2005) argued that the "math wars," a several decade-old fight over the value of *conceptual knowledge* versus *procedural knowledge* in mathematics education, has constrained our understanding of both terms (p. 408). To that end, he introduced the concept of a "deep procedural knowledge" which he described as "knowledge of procedures associated with comprehension, flexibility, and critical judgment…distinct from (but possibly related to) knowledge of concepts" (p. 408). This is a shift in mathematics education from pedagogical practices focused on getting the right

answer or using the right procedure to deepening students' mathematical understanding, flexible problem-solving ability and analytical competencies.

However, many scholars argued that this paradigmatic shift in the field of mathematics endorsed by NTCM (1989, 2000) and exemplified in Star's (2005) "deep procedural knowledge" fail to provide certain racial minority students "the kind of mathematics that allows them to fully function in school and society" (e.g. Martin, 2003; see also Meyer, 1989; Tate 1997; Tate & Rousseau, 2002). This new wave of reform in mathematics education, while focused on improving students' mathematical ability and achievement, has not addressed what Martin (2009) called the "racial hierarchy of mathematics ability" created by the preponderance of studies concerned with racial differences in mathematics achievement. In fact, Martin (2003) observed that by and large "equity in mathematics education remained elusive" for black students (p. 9). Gutstein (2006) attributed this to the fact that mathematical content and pedagogies taught at the majority of teacher training programs across the U.S. are mostly centered around "classical" mathematics, and are subsequently often disconnected from students' lived experiences, and inadequate in bridging the race-based achievement gap in mathematics.

The 1970's saw the emergence of a "critical sociology of education" paradigm which viewed and contextualized the schooling process as "a means for perpetuating unjust societal inequalities" (Reyes & Stanic, 1988, p. 28). For instance, some critical sociologists such as Bowle and Gintis (1976) argued that schools "are not value-free institutions" and that they "impose the inequalities of the wider society on students" (p. 28). Others underlined that minority students' persistent low academic performance "despite the meritocratic ideology of

schooling" can be explained and perhaps best understood as a form of "resistance" against "the messages of the school curriculum and school officials" (Reyes & Stanic, 1988; see Willis, 1977; Grieb & Easley, 1984). Such resistance has been characterized and explained as "oppositional identities," or "cultural inversion," where minority students, black boys in particular, view schooling as "learning…the culture and language of White Americans, that is, the learning of the cultural and language frames of reference of their *enemy*, or their *oppressors*" (Ogbu, 1992, p. 10). Thus, for such students, academic success requires and symbolizes the appropriation of the dominant White culture and the rejection of their personal identities and communities.

The search for a better understanding of classroom processes led a number of educational researchers in the field of mathematics to focus on students' identity construction within the context and in response to mathematics classrooms, curricula, instructions and activities. Students' performance is deconstructed as "persistence and interest in mathematics and their motivation to learn mathematics" (Cobb, Gresalfi, & Hodge, 2008, p. 2). Learning is operationalized and understood as "closing the gap between *actual identity* and *designated identity*" (Sfard & Prusak, 2005, p. 14). Cobb et al. (2008) referred to this bridging of a gap as the continuous and recursive friction that exists between students' "*personal identities*" and the "*normative identity* [of] a doer of mathematics established in the classroom" and in the broader society (p.4). As a result, the process of learning or performing in a classroom setting "implies…becoming a different person;" it "involves the construction of [a new] identity" (Sfard & Prusak, 2005, p. 15; see Lave & Wegner, 1991). Doing mathematics is viewed as a socialization process in which success is dependent on students' ability and/or willingness to

fulfill their "mathematical obligations" and accept "the role of an effective student…constituted in the classroom" (Cobb et al., 2008, p.4).

To that end, making sense of race-based differences in students' math performance requires a "shift within the discipline of mathematics from a mainly cognitive and pedagogical perspective" to a better understanding of those students' personal identities constructed in response to the "microculture" of mathematics classrooms, and within the larger mainstream American culture (Greer & Mukhopadhyay, 2003; Cobb et al., 2008; see also Martin, 2000; Boaler & Greeno, 2000). Martin's (2000) seminal *Mathematics Success and Failure Among African-American Youth: The Roles of Sociohistorical Context, Community Forces, School Influence, and Individual Agency* attempted to do just that. Using a multilevel analytical framework—a *sociohistorical level*, a *community level*, a *school level* and an *intrapersonal level*—the author sought to situate and investigate the identity construction of African American boys in mathematics classroom within the context of the U.S history of racial injustices, the black communities' response to that history, its impact on the "negotiations of norms" in the classroom, and the ways in which those levels help shape students' "views of what it means to know and do mathematics in the classroom" (Cobb et al., 2008, pp. 3-4; see Martin, 2000). Martin (2000) advanced the concept of the "mathematics socialization" of black boys which he described as "the processes and experiences by which individual and collective mathematics identities are shaped" (p. 19). He made us of a multidimensional conceptual framework that "account for the sociohistorical and present day mathematical experiences of African

Americans" (pp. 19-20) in order to offer insights into the friction that exists between students' *personal identities* and the *normative identity of a doer of mathematics*.

In fact, some researchers in the field of mathematics concerned with increasing percentage of minority students' in stem education and career paths have suggested a reconceptualization of mathematics instruction and curricula. The most successful and documented of such enterprise is the *Algebra Project* (AP), founded in the 1980's and run by civil rights activist and mathematics educator, Robert P. Moses. The project's main concern was with "the mathematical and scientific literacy requirements that [were] becoming prerequisites both for citizenship and for competing in the emerging global economy" (Silva, Moses, Rivers, & Johnson, 1990, p. 378). More specifically the *Algebra Project*, through its "Transition Curriculum" sought to challenge the conventional "ability model" in mathematics education which assumes that only certain "gifted" or "inclined" students should be enrolled and can succeed in advanced mathematics courses (Silva et al., 1990, pp. 377-378). Moreover, by challenging teachers to create learning environments "grounded in real life experiences and to support students in [understanding] the social construction of mathematics," the project rejected the perception of mathematics education as a neutral or value-free academic enterprise. In fact, it shared the epistemic inclination of the critical sociology movement of the 1970's and reiterated the need for students to learn "through their own experiences about the social construction of knowledge" (Silva et al., p. 382).

This is evidenced in Esmonde's (2014) study of the impact of connecting mathematics content to the context of students' lives. She found that "although mathematics is often

represented as a positivist field with straightforward methods and single correct answers," mathematical tasks with a *social justice* orientation engaged students more meaningfully, and helped them situate, evaluate their experiences and beliefs within larger social issues such as "wealth disparities," "high-poverty neighborhoods" (p. 385). In fact, one of Esmonde's most salient findings was that students' discussions about the reasonableness of their answers was not solely based on the procedures or methods used to solve the task; students' arguments and interpretations of their results were influenced by their social and cultural backgrounds (pp. 384-387). The idea of purposing mathematics education as an analytical tool to help students understand and explain social issues is an illustration of Dewey's (1929) My Pedagogic Creed in which he defines education as a process aimed at helping a child "act as a member of [an] unity" (society) by emerging out of "his original narrowness of action and feeling" (p. 291). And he argued that educational processes which do not account for the student's individual "powers" will likely "result in friction…or arrest of the child nature" (p. 292).

However, critics of mathematics curricula, instructions and studies aimed at connecting mathematical content to students' social realities have expressed concerns about the growing number of pedagogical practices and scholarship in the field not focused enough on mathematical content. One of their key concerns is that mathematics knowledge, defined and restricted to "all *ways of understanding* and all *ways of thinking* that have been institutionalized throughout history" (Harel & Koichu, 2010, p. 116; see Harel, 2008b; Heidi, 2010) is at risk of losing "its identity" as a discipline. Harel (2008b) asserted that creativity in mathematics is mathematical only if it is consistent with existing "institutionalized" mathematical knowledge, or

is accepted by the "existing edifice of mathematics" (p. 10). Moreover, during an NTCM (2010)-sponsored symposium entitled *Keeping the Mathematics in Mathematics Education Research*, scholars observed that many of the studies focused on the context in which students are experiencing mathematics would "remain intact if each mention of 'mathematics' [were to be] replaced by a corresponding mention of another academic subject such as history, biology or physics" (Martin, Gholson & Leonard, 2010, p. 4; see Harel, 2010). This was echoed in Cobb, Gresalfi, and Hodge's (2008) investigation of students' mathematics identity development in which they argued that studies focused on the impact of students' sociocultural backgrounds on their mathematics identities "are not specific to mathematics" and can be applied to any academic subject or any other academic class (p. 3).

Purpose of Study

The impact of students' socioeconomic background on their academic performance and prospect has been very well documented and evidenced since the Coleman Report (e.g. Anyon, 1997; Coleman, Campbel, Hobson, McPartland, Mood, Weinfeld, & York, 1966; Connell, 1994; Noguera, 2003; Sharkey 2013; Tate & Rousseau, 2002; Wilson, 2009). Similarly, many studies have shown how mainstream beliefs about gender norms have shaped students' academic identity and success/failure in high status disciplines like mathematics (e.g. Beane, 1988; Burton, 2001; Fox, Tobin, & Brody, 1979; Harkness & Stallworth, 2013; Riegle-Crumb, Moore, & Ramos-Wada, 2010; Sells, 1973). Likewise, there is a very extensive scholarship on how race—racial injustice and racial identity construction—can inform and significantly affect students' academic performance and success (e.g. Fordham & Ogbu, 1986; Noguera, 2008; Ogbu, 1981;

Sharkey, 2013). It is evident that constructs like socioeconomic status, gender and race individually and collectively play a significant role in academic identity formation and performance. However, because of the complexity and importance of each of those constructs in advancing theory about students' academic success and failure, I choose to focus this research project on race and its relationship to students' academic identity construction. In so doing, this study joins others (e.g. Martin 2000, 2009) in challenging mainstream beliefs of the mathematical ineptitude of black students; it also addresses the scarcity of studies in the field on high achieving black students' math identity construction in response to dominant narratives of what it means to be a math person.

The present study investigates black students' *mathematics confidence* and how it shapes and is shaped by their perceived ability, experiences in mathematics classrooms and their view of the purpose of mathematics in their present and envisioned lives. There is considerable variability in the definition of "confidence" as it relates to learning and academic performance (e. g. Burton, 2004; Buxton, 1991; Evans, 2000; McLeod, 2002). However, Burton (2004) remarked that most scholars concerned with the notion of confidence, "a confluence of feelings relating to beliefs about the self, and about one's efficacy," share the belief that students' "affective domain" can have significant impact on their academic performance (p. 360; see also Evans, 2000). Moreover, Burton (2004) argued that "learners construct themselves" based on accumulated experiences and feelings in a particular academic domain, and that "these feelings are intimately connected with both the social settings and the learning experiences within them" (p. 360).

Using ethnographic methods this study proposes a more nuanced and complex understanding of the intersectionality of "classroom processes" and students' "personal identities," and how the two inform students' confidence and potentially affect their academic performance. Consistent with the extant literature on "the investigations of the identities that students are developing in mathematics classrooms" (Cobb et al., 2008, p. 3; see also Martin 2000; Boaler & Greeno, 2000), I argue that this study raises critical questions and legitimates the need for more research focused on black students' perception of and identification with mathematics. Through an exploration of students' "actual and designated" math identities (Cobb et al., 2008, p. 4; see also Sfard & Prusak, 2005), this study offers new insights into the following:

1. How does black students' accumulated experience in mathematics education shape their perception of and identification with mathematics?
2. How does race affect black student's math confidence and sense of belongingness to the academic domain?

Significance of Study

Martin (2009) observed that one assumption evidenced in many studies focused on race-based achievement gaps in mathematics education is that black students are the bottom of the racial hierarchy of mathematical ability. In spite of the abundance of empirical evidence of the failure of black students in mathematics, very little is known about how those students develop mathematics identities that negatively affect their academic performance (Martin, 2000, 2009).

This study reinforces other studies' call to develop new perspectives with which to analyze the persistence of race-based achievement gap in mathematics. This research project examines the mathematics confidence of 11 black students enrolled in honor's pre-calculus within the context of what Martin (2009) called the *racial hierarchy of mathematics ability* in America. However, as stated earlier, and as remarked by Cobb et al. (2008), many similar studies' findings and analyses are often mostly or exclusively focused on the broader social and cultural aspects of students' mathematics socialization and identity formation, and not enough on the micro-social and pedagogical practices that take place daily in mathematics classrooms. Moreover, even fewer studies focus on high-achieving black students, their perception of math education and how they reconcile success in the classroom and being stereotyped as failure in the domain. In light of this, this study investigates students' views on learning and doing math and their identification with the discipline in response to mainstream beliefs about the "normative identity of a doer of mathematics" (Cobb et al., 2008, p. 4).

CHAPTER 2

LITERATURE REVIEW

Brief History of Mathematics Education

Many historians in the field of education who have studied the birth and evolution of America's public school system have consented that "the education wars of the past century are best understood as a protracted struggle between content and pedagogy" (Klein, 2003, p. 176). This is even more evident in the field of mathematics education where mathematicians, educators, researchers and reformers are often at odds between "what to teach" and "how to teach" in the classroom (pp. 176-177). Klein (2003) delineated and chronicled the key reforms in mathematics education in America. His historical account began with the progressive movement of the 1920's that started infiltrating and challenging mainstream beliefs around education. More specifically, Klein (2003) focused on the impact that educational leader William Heard Kilpatrick, a protégé of philosopher John Dewey and leader of the progressive movement had on the field of mathematics education. Kilpatrick believed that "subjects should be taught to students based on their direct practical value, or if students independently wanted to learn those subjects;" and as it pertains to mathematics education, he argued that subjects like Algebra and Geometry were "harmful rather than helpful to the kind of thinking necessary for ordinary life" (Klein, 2003, p. 177). Moreover, Klein (2003) observed that the progressive movement's central tenets were substantiated by psychologist Thorndike's findings which challenged the traditional view of mathematics education as "a form of mental discipline" with "utilitarian [or useful]

purposes" (pp. 177-178). Indeed, Thorndike's findings "cast doubt" on the transferability of skills like solving complex algebraic problems into other academic disciplines and professional careers. The social significance of learning mathematics along with the pedagogical beliefs that underpin instruction and curricula were brought into question by the progressive movement.

The fight over math content and pedagogies intensified and became part of the United States' national agenda to ameliorate its international standing and economic prospects after World War II (Herrera & Owens, 2001). One illustration of this is the former U.S.R.R.'s launch of *Sputnik* in 1957 which was perceived as a major embarrassment for the U.S., and as evidence of the need to overhaul academic standards for mathematics and science instructions in public schools (Klein, 2003, pp. 181-182; see also Herrera & Owens, 2001). Many believed that American students were not acquiring the math and science skills necessary to compete in a technology-driven market and help the country maintain its dominance over an increasingly more globalized world. Herrera and Owens (2001) argued that the "new math" of the early 1950's was born out of the "coalescence of concerns coming out of World War II" combined with mounting international pressures and growing "discontent" with secondary mathematics education (p. 84).

The epistemic underpinnings of the new math movement can be traced back to the progressive movement of the 1920's, its resurgence in the 1960's, and some of the movement's well known psychological theorists. For instance, Jean Piaget, the renowned developmental psychologist and prominent voice of the constructivist movement, is believed to be responsible

for the incorporation and widespread adoption of "concrete examples and physical manipulatives" in elementary mathematics education (Herrera & Owens, 2001, p. 85). His famed *The Child Conception of Numbers* coincided with and strongly influenced the "beginnings of the the new math era" as it relates to elementary age students' cognitive readiness to learn certain mathematical concepts (p. 85; see also Piaget, 1952). Similarly, concepts like "discovery of mathematical ideas," problem solving, and contextualized learning promoted by the cognitive psychologist Jerome Bruner (1960, 1966) gained in popularity among practitioners and researchers in the 1960's and early 1970's. Consistent with Piaget's "stages of cognitive development and his concepts of conservation and reversibility," Bruner's three stages of mathematical representations—*enactive* (concrete), *iconic* (pictorial), and *symbolic* (abstract)—played a significant role in the reimagining of mathematical curricula, methods of instruction and assessment during the new math movement (Herrera & Owens, 2001, pp. 85-87).

However, the new math movement was met with considerable resistance from mathematicians, educational researchers and policy makers "concerned with [a] lack of attention to basic skills" in mathematics classrooms and the decrease of students enrolled in and completing advanced mathematics courses (Klein, 2003, p. 180; see Ravitch, 2000; Herrera & Owens, 2001). The country's 1960's and 1970's economic, political and social landscape was not conducive to the movement's seeming lack of structure, rigor, and absence of skills-oriented teaching in the classroom. For instance, reports on the state of public education in the 1970's and 1980's underscored the need for students, particularly in mathematics and science classrooms, to be taught and master skills and conceptual understanding before they can participate in

challenging problem solving (*A Nation at Risk*, 1983; NCTM, 1980). Others have argued that the the resurgence of the progressive movement in the 1960's failed to address the need of poor minority students who often lacked the home support and resources needed to succeed in a student-driven classroom environment (Klein, 2003, pp. 188-189; see Delpit, 1986). Delpit (1986), one of the staunchest critic of the movement, posited that:

> White kids learn how to write a decent sentence. Even if they don't teach them in schools, their parents make sure they get what they need. What about our kids? (see Klein, 2003, p. 188)

Moreover, a continuous decline in students' standardized test scores throughout the 1970's and in the 1980's substantiated the belief that the new math movement, along with the progressive movement, and their "organic spontaneity of learning" concept were failing students (Kozol, 2005), thus contributing to the deterioration of the American public school system.

Mathematics for All

The National Council of Teachers of Mathematics (NCTM), founded in 1920 largely in response to the progressive movement's first assault on mathematics education, heeded the recommendations of *A Nation At Risk* (1983) and provided new standards for mathematics education. These standards, delineated in *Curriculum and Evaluation Standards*, focused primarily on creating "a coherent vision for what it means to be mathematically literate" in a world where mathematics "is being applied in diverse fields" (Martin, 2003, p.8; see NCTM, 1989). Additionally, NCTM (1989) sought to address the history of academic disparity between white students and their black/Latino counterparts. It brought attention to "The social injustices

of past schooling practices" perpetrated on women and minority students; and reiterated *A Nation At Risk*'s warning that "Equity has become an economic necessity" (NCTM, 1989, p. x).

Nearly two decades later, America continued to fall behind most other advanced nations in mathematics education and disparities between underserved minority students and their white counterparts persisted (Martin, 2003, pp. 8-9; see Lee, 2002; Schoenfeld, 2002; Tate, 1997). NCTM's (2000) *Principles and Standards for School Mathematics*, a reevaluation of the organization's 1989 recommendations and the formulation of other standards for mathematics education in the 21st century, sought to address those very issues. However, Martin (2003) observed that the organization's new sets of standards by and large abandoned its initial quest for social equity in mathematics education (pp. 9-10). And even though the rhetoric "*Mathematics for All,*" embraced by NCTM (1989/2000) and many other reform initiatives in the field of mathematics at the beginning of the 21st century stressed the importance of culturally competent curricula and culturally responsive classrooms, it failed to adequately address "the structural and social realities faced by marginalized students outside of the class" (Martin, 2003, p. 7). One of the reasons is that the movement *Mathematics for All* oversimplified and potentially undermined "the complexities of race, minority/marginalized status, underachievement…" (p.10) that are salient in advancing theories about the persistence of academic failure for many black students in mathematics. In fact, many scholars whose works focused on the history of reform initiatives in mathematics education have highlighted the fact that in most of those initiatives, the concept of social justice or equity has been mostly absent or at best "myopic" (Abraham & Bibby, 1988; Anderson, 1989; Apple, 1992/1999, 1995; Campbell, 1989; D' Ambrosio, 1990; Frankenstein

1990, 1994; Gutstein, 2002, 2003; Martin, 2000b; Martin, Franco, & Mayfield-Ingram, 2003; Stanic, 1989; Tate, 1995; Tate & Rousseau, 2002).

Social Justice Oriented Mathematics Education

In the midst of the concerns about the state of mathematics education in America, the country's mediocre standing on the international stage, and a continuous cycle of fruitless reform initiatives, the concept of a 'social justice oriented mathematics' began to emerge. Greer and Mukhopadhyay (2003) observed that the field of mathematics education was undergoing paradigmatic changes that re-conceptualized mathematics as "a human activity" informed and shaped by sociocultural and economic forces of mainstream society (pp. 2-3). In this new paradigm mathematics performance, instruction and curricula are examined within and in relationship to a specific sociocultural and economic context. For instance, Apple (2000/1999), through a critical examination of recent reform initiatives in mathematics education, underscored the potential of reform initiatives, often motivated by the economic reality and demands of the time, to exacerbate social inequalities in America. Similarly, Martin (2009) challenged the history of the assumed neutrality of mathematics education and the widely accepted achievement gap between minority students and their white counterparts in mathematical performance. He (2009) argued that "the objectivity that is often assumed for outcomes on national assessments…are smaller pieces of larger societal narratives that…serve the purpose of constructing and reifying not only African Americans but also Latinos and Native Americans as intellectually and academically inferior" (pp. 296-297). In other words, mathematics, elevated as a high status discipline, has by and large contributed to the perpetuation and substantiation of

historically held beliefs of the intellectual inferiority of Blacks and Latinos. To reverse this trend, some scholars in the field of mathematics education have argued for the need of mathematics curricula, pedagogies and instructions to be more inclusive of student's lives outside of the classroom (Anderson, 1990; Ladson-Billings, 1995/1997; Martin, 2000; McNair, 2000; Tate, 1990; Silver et al., 1990/1995).

This is arguably one of the toughest obstacles for researchers and practitioners in mathematics education committed to incorporate students' sociocultural backgrounds into their mathematics learning. Cuban (1983), in a report that focused on the history of educational reform initiatives that emerge and vanished between 1890 and 1980, found that teaching practices and students' learning experiences have remained mostly unchanged since the inception of the public school system. Teacher-centered instruction where students' learning experience is dominated and controlled by "teacher-talk" has withstood a hundred years of reform initiatives and educational movements and continued to be the reality for the majority of students enrolled in the country's public schools (Cuban, 1983, pp. 160-161). Because of this, students' role in the classroom has traditionally been defined as "knowledge consumer" at the mercy of the teacher, the sole "knowledge producer" (McNair, 2000, p. 551). In mathematics classroom, this "transmission model" has constricted students' learning and performance to memorizing facts and procedural steps often dismissive and exclusive of their varied learning styles, their natural abilities and any meaningful conceptual understanding. McNair (2000) asserted that, moving from the traditional and constrictive transmission model, mathematics curricula and teachers need to create a learning environment where students' "experiences outside of the classroom"

play an important role in their academic participation and performance (p. 552). However, it's not evident to most mathematics teachers, regardless of the extent of their mathematical knowledge or pedagogical competence, know how to successfully connect students' lived experiences to mathematical concepts.

One of the reasons preventing mathematics teachers to successfully design and implement mathematics instruction relevant to students' lived experiences is that pre-service and in-service teachers often share a "restrictive" view of equity or equality (see for example Crenshaw, 1988; Ladson-Billings, 2009; Tate & Rousseau 2003). Crenshaw (1988), using a "critical legal studies" theoretical lens, posited that there were two views of the notion of equity with regards to race-based and socioeconomic policies aimed at addressing inequality in the U.S. One view which she (1988) characterized as "expansive" stresses "equality as a result, and looks for real consequences for African Americans;" the other view, described as "restrictive," "treats equality as a process, [and downplays] the significance of actual outcomes" (p. 1341). Tate and Rousseau (2003), in an ethnographic study of seven in-service mathematics teachers, found that teachers were more inclined to subscribe to the restrictive notion of equity. The authors (2003) found that mathematics teachers viewed equity in the classroom as "treating students equally" (pp. 212-213). According to Ladson-Billing (2009), treating every student the same is different and antithetical to treating them equitably. In fact, she (2009) argued that equity in the classroom should mean working with every child differently (p. 36). The problem, she remarked, is that many teachers and pre-service teachers, blinded by the "passion for equality in the American

ethos" confuses equal with sameness. As a result, students with varied academic interests and abilities are subjected to a same, one-size-fit all way of learning.

Many teachers, particularly in mathematics and science education, when prompted, often claim that they don't see "racial differences" and don't see the need to account for them in their lesson plans and instructions (Gay, 2002; Ladson-Billings, 2009; Tate & Rousseau, 2003). They believed that students' racial backgrounds are mostly irrelevant and unsuited for an effective classroom environment. Tate and Rousseau (2003) underlined that white teachers in their reflections on equity were more likely to adopt "color blindness" out of fear of stereotyping racial and ethnic minority students (p. 213). In their view, acknowledging students' racial differences is synonymous to harboring racist sentiments towards students. Similarly, Gay (2002) observed that mathematics and science teachers' resistance to the integration of racially and culturally competent pedagogy in the classroom was motivated by their belief that it would cause "too much of a conceptual and substantive stretch for their subjects to maintain disciplinary integrity" (Gay, 2002, p. 107). Gay attributed this to the fact that teachers' multicultural knowledge is often limited to a selected high-profile racial or/and ethnic minority figures in entertainment or politics, and doesn't include "less visible but very significant contributions of ethnic groups in science, medicine, technology, math…" (p. 107).

Ladson-Billings (2009) argued that not acknowledging a student's race is "dismissing one of the most salient features of the child's identity" (p. 36). More importantly, Tate and Rousseau (2009) asserted that colorblindness prevents teachers to adequately assess and understand "the impact of racism" on students' learning and academic performance.

Furthermore, the authors (2003) argued that "This failure to acknowledge the racist structures in society and schooling must be…accompanied by a failure to question and disrupt those failures" (p. 213). In other words, teachers' refusal or inability to examine the ways in which they and the school are implicated in the persistence of the academic underachievement of minority students, particularly Blacks and Latinos in mathematics, preclude them from effecting meaningful changes in the classroom that can halt or reverse the history of academic failure of those students.

Even in more progressive learning environments where the traditional transmission and teacher-centered model is substituted with a more participatory and student-centered model, low-income students often struggle transitioning from the role of consumer to that of producer of knowledge (Bruckerhoff, 1995; McNair, 2000; Tate, 1994). One of the key reasons, delineated in Bruckerhoff's (1995) ethnographic study of an under-resourced and underperforming urban public school in Cleveland, is that teachers' implementation of problem-solving approaches in their mathematics classrooms failed to address and relate to students' difficult social realities outside of school. Poor urban students' lives outside of the classroom are often plagued by "homelessness, deprivation, abuse," and students are often lured to "alcohol, drugs and crime" as means to escape or respond to their social realities (Bruckerhoff, 1995, p. 325). And often those students exhibit difficulty "setting their reality aside to engage in mathematics classroom investigations that do not connect to their reality" (McNair, 2000, p. 559; see also Bruckerhoff, 1995). The problem, McNair (2000) observed, is that schooling, even in more student-centered classrooms, separates "scientific [or academic] concepts" from a child's daily activities. The

author (2000) challenged Vygotsky's (1986) view that scientific concepts learned in the classroom are necessary and motivate students to make sense of and organize their lived experiences. McNair (2000) argued that this gives primacy to schooling or academic knowledge over students' daily experiences. It creates a hierarchical relationship between academic knowledge and lived experiences where students are often required to engage with concepts "before his or her real life experiences…present any motives for learning them" (p. 555). McNair (2000) believed that students' social realities provide them the motivations to engage with academic concepts. Therefore, academic curricula, methods of instruction, academic concepts and tasks aimed at engaging students meaningfully must begin with and be centered around students' lives outside of the classroom (e.g. Dewey, 1973; Ladson-Billings, 1997).

This is even more critical for students living in communities trapped in concentrated and "multigenerational poverty" caused by decades of overt and subtle race-based housing and economic policies (Noguera, 2003; Sharkey, 2013; Wade, 1995; Wilson, 1989; Wilson, 2008/2009). It is critical because families that live in poverty today have more than likely "lived in a similarly poor neighborhood for multiple generations" (Sharkey, 2013, p. 7). Moreover, Sharkey (2013) observed that "living in high-poverty neighborhood during adolescence doubles the likelihood that a child will drop out of high school relative to living in a low-poverty neighborhood" (p. 108). In light of this, and the fact that mathematics has become essential to economic and social mobility in this technology-driven global economy, many have come to view mathematics education as a necessary tool to address America's history of social injustice perpetrated against racial minority groups.

For instance, Moses (2001), in *Radical Equations: Civil Rights from Mississippi to the Algebra Project* which chronicled the birth and evolution of the Algebra Project, argued that the "most urgent social issue affecting poor people and people of color is economic access…[and] economic access and full citizenship depend crucially on math and science literacy" (p.5). He argued that access to quality mathematics education is the new millennium's civil rights issue. Moses (2001) likened his Algebra Project's attempt to increase the number of middle-school aged black students enrolled in and successful in algebra to the 1960's voter registration movement aimed at giving blacks "control over their political lives" (p. 4). Similarly, Gutstein (2006) asserted that mathematics education for poor black students should help them develop "sociopolitical consciousness of the conditions of their lives; a sense of social agency…and positive social/cultural identities" (p. 332). This way of conceptualizing mathematics education as a tool for social and political empowerment is what many scholars in the field refer to as *mathematics for social justice* (D'Ambrosio, 1990; Frankenstein, 1987/1995/1998; Gutierrez, 2000/2013; Gutstein, 2006; Martin, 2000; Moses, 2001; Stinson, 2004; Tate, 1994; Tate & Rousseau, 2003).

Mathematics for social justice repurposed the teaching and learning of mathematics as a tool to help students, particularly black students from inner-cities who have been and continue to be subjected to race-based and socioeconomic segregation and injustice in school districts across the country (Kozol, 2005; Orfield, Frankenberg & Lee, 2003; Orfield, Frankenberg & Siegel-Hawley, 2010) develop a better understanding of their social realities and equip them with skills needed to respond to social inequity. For example, Gutstein (2013), teaching mathematics in a

school located in a "densely populated, large Mexican immigrant community" in Chicago beset with issues like unemployment and poverty, decided to focus a unit on "Studying Neighborhood Displacement" (pp. 102-103). The author (2013) observed that displacement and gentrification were part of students and their families' history. So, he asserted that it was critical for the mathematics that students were learning to be oriented toward providing insights into housing, farming policies and mortgage lending practices, and their relationship to the racial and socioeconomic composition of communities on the U.S.-Mexico border. The unit began with the concept of borrowing money from a bank (like a mortgage) with interests and having to pay more on a house for instance than it is worth (p. 104). Students began to question and critique the 'legality' of banks' lending practices and their impact on the notion of affordability considering their community's modest median income. Then the unit shifted to immigration and deportation, and their relationship to the United States Department of Agriculture's policies to, for instance, subsidize the making of tortillas instead of the farming of corn (p. 106). Gutstein (2013) argued that students' use of "serious math—pre-calculus, algebra, discrete mathematics, quantitative reasoning" to "analyze the sociopolitical conditions of their lives" allowed students to *read* and *write the world* with mathematics (pp. 106-109; see Freire & Macedo, 1987). In other words, this is an example of mathematics for social justice where students are challenged and encouraged to use mathematics to unearth the sociopolitical and economic processes that shaped their lived experiences so that they can be positioned in a way to engage with and *write the world* as they see fit.

The importance of conceptualizing mathematics education as a vehicle to read and write the world and its potential effect on marginalized communities was illustrated by Gutstein's (2006) ethnographic study of a group of Latino parents whose kids were enrolled in the author's mathematics class. Gutstein (2006) designed his mathematics class after Freire and Macedo's (1987) famed concept of educating students to read and write the world (p. 334). Meaning that students will be able to critically examine concepts and social realities such as democracy which in the U.S. can be viewed as "a system of elite decision and public ratification" (Freire & Macedo, 1987; see also Chomsky, 1987). Mathematics to read and write the world is defined as a means to "understand relations of power, resource inequities, and disparate opportunities between social groups…based on race, class, gender, language and other differences" (Gutstein, 2006, p. 335). Gutstein (2006) focused his study on parents' perspective, response and overall disposition concerning their kids learning mathematics to read and write the world. The author found that the sample of 10 parents selected for this study, although not politically active or with strong political allegiance, were supportive of the type of mathematics that their kids were learning. In fact, most of the parents who participated in the study conceded that they had experienced "injustice themselves, knew that their communities lived with it," and that their kids had to "deal with it or were already dealing with it in their lives" (p. 352). Thus, the parents believed that mathematics education, "a central part of life" in the 21st century, should help students develop a "consciousness of oppression, and the necessity to resist it" (pp. 352-353). Moreover, Gutstein (2006) posited that mathematics for social justice, because it empowers historically marginalized students with a consciousness of the sociopolitical roots of injustice and

the agency to address social inequities, afford racial and ethnic minority students the critical space needed to develop "positive and cultural identities" (p. 334). The author's beliefs were echoed and affirmed by the participants of this study who fully endorsed Gutstein's (2006) mathematics curriculum and instruction oriented towards helping students to write and read the world because it ultimately challenged mainstream views of the non-academic disposition and mathematical deficiencies of Black students.

One of the key assumptions underpinning the concept of mathematics for social justice is that mathematics education for poor black students has been by and large an illustration of Foucault's (1966/1984/1990b) theory around the power of knowledge, "how ideas and subjectivities come into existence and how they limit what is possible" (Allan, 2011, pp. 276-277; see Foucault, 1984/1990b). Foucault (1966) advanced the theory of *truth games* in which 'truth' or knowledge is defined as an exercise of power and is used to control. More plainly, Allan (2011) remarked that truth games are "the rules, resources and practices that go into making something true for humans" (p. 277). For black students, in spite of numerous reform initiatives, the ascension and vanishing of pedagogies on how to teach mathematics, poor academic performance constitutes their truth games. Martin and McGee (2011) remarked that the majority of Black students are "turned away" from mathematics and science education at an early age as a result of systemic issues within their schooling experiences such as "tracking and differential access to higher-level mathematics curricula, poor access to the best-qualified teachers and inadequate resources," and a failure to connect mathematics to their lived realities (p. 48; see also Martin, 2000; Martin & McGee, 2009; Moses & Cobb, 2001; Nasir & Hand,

2008; Oakes, 1990; Spencer, 2009; Tate, 1994/1995a). Nonetheless, the dominant narrative in the scholarship on mathematics education is that black students are mathematically inferior to their white and Asian counterparts; and policy initiatives are overwhelmingly focused on bridging the achievement gap between black students' mathematical performance and their white/Asian counterparts. The litany of studies and empirical evidence on the racial differences in mathematics scores has created a *racial hierarchy of mathematics ability* in America, a truth around who can be successful in mathematics and who cannot (Martin, 2009). This truth has colored teachers' attitudes toward black students' mathematical aptitude, it has shaped students' beliefs about their mathematical abilities, and it has created a set of rules, resources and practices that serve to uphold the truth game around mathematics education (McGee & Martin, 2001, p. 49; see also Martin, 2009). Allen (2011) refers to this as "choreographed acts that interact with bodies—sets of behaviors that together define a way of doing something," of actualizing and maintaining a truth (p. 277).

More importantly the truth around the field of mathematics education has also established an "identity" for what constitutes mathematics education research (Greer & Mukhopadhyay, 2003; Martin, Gholson & Leonard, 2010). Harel (2010), in his address at a research symposium hosted by NTCM entitled *Keeping the Mathematics in Mathematics Education*, echoed the concerns of a number of scholars in the field of mathematics about the proliferation of studies "adscititious [not integral] to mathematics and the special learning and teaching of mathematics" (p. 4). Mathematics education, he argued, is defined as the body of knowledge and a research domain that are distinct from other disciplines like psychology, sociology and ethnography, and

that the field is in danger of "losing its identity." Martin et al. (2010) asserted that the idea of preserving the neutrality and identity of mathematics education "represent public displays of power and privilege" (p. 13). It acknowledges the existence of a dominant and narrow view of mathematics education and research studies in the field that don't "address issues of equity" and fail to acknowledge the "gate-keeping role that mathematics has served in limiting meaningful participation in schools and society" for many racial and social groups (p. 17). This view of mathematics education exemplifies one of Foucault's (1975/1995) central tenets about the pernicious power of knowledge and its foothold on social realities. In Foucault's (1975/1995) *Discipline and Punish: The Birth of the Prison*, he argued that "There is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations" (p. 27). In other words, what has constituted legitimate research inquiry and knowledge in the field of mathematics education has regulated and controlled the production of 'knowledge' about mathematics, and has also established an identity and a face of a *doer of mathematics*.

Subsequently, this traditional view of mathematics as acultural and apolitical coupled with the abundance of data on who's mathematical literate and illiterate has not only created "an order of the world" of mathematics education, it has also denied the 'mathematical illiterates' a critical space "to discover that these orders are perhaps not the only possible ones or the best ones" (Foucault, 1966/1994b, p. 20). Martin et al. (2003) argued that this *Keeping the Mathematics in Mathematics Education* movement represents a "back-to-basics" approach to teaching which has "been used to stratify students, affording privilege to some and limiting

opportunities to others" (p. 14; see also Dime, 2007; Gutierrez, 2000, 2008; Gutstein, 2003; Leonard, 2008, 2009; Stinson, 2004; Tate, 1995). In this schema, knowledge of mathematics presupposes and constitutes the process of learning "a set of rules and algorithms" unaffected by larger sociopolitical and cultural forces; and the persistence of the underachievement of black students in mathematics serves to legitimize the long-standing history of mainstream beliefs about the academic inferiority of those students compared to their white counterparts. This reified the notion that mathematics, a high-status discipline, is only for the abled, and it gives credence to the social reality that certain racial/ethnic and/or social groups are not mathematically inclined. The preservation of the identity of mathematics education can be viewed as an attempt to control and limit membership into the field while silencing the calls of scholars concerned with issues of social inequities to focus studies on the mathematics socialization and mathematical identity formation of students.

Racial Identity Formation

A salient and shared aspect of studies, curricula and pedagogical practices that subscribe to the mathematics for social justice paradigm is students' identity formation within the context and in response of mathematics as a high-status discipline. Social and cognitive psychologists have advanced various operational definitions for identity; they have also devised numerous theoretical frameworks with which to analyze and evaluate identity development (e.g., Brukbaker & Cooper, 2000; Chatman, Eccles, & Malanchuck, 2005; Erikson, 1968, 1980; Gleason, 1983; Grotevant, 1987, 1992; Harter, 1990; Waterman, 1993). However, Chatman, Eccles, and Malanchuck (2005) argued that the various definitions that proliferate the extant

literature on identity converge to the view of "identity as an ongoing dynamic process whereby individuals establish, evaluate and reevaluate, and reestablish who they are and are not relative to others in their environments" (p. 117; see Erikson, 1968). Within the context of schooling, this process "…implies becoming a different person" (Lave & Wegner, 1991, p. 53) and it requires the appropriation of a secondary dominant discourse (Gee, 1992, 1994, 1996; Gee & Green, 1998; Hicks, 1995; Luke, 1995). Gee and Green (1998) observed that this conceptualization of identity has provided valuable insights on "how knowledge constructed in classrooms (and other educational settings) shapes, and is shaped by, the discursive activity and social practices" of social actors within the classroom, within students' communities and within the context of larger social and cultural realities. Schooling, a socialization and acculturation process, involves tension and negotiations between students' personal identities and the identity of a learner defined in a given classroom setting. For instance, in mathematics classrooms, students have to reconcile or bridge the gap between their personal identities and the identity of a "mathematical person, namely, the role of an effective or competent mathematics student…constituted in the classroom" (Cobb, Gresalfi, & Hodge, 2008, p. 4).

However, to advance any theory or analysis about students' mathematical identity formation or how students negotiate the tension between their personal identities and the *normative identity* of a doer of mathematics (Cobb et al., 2008, pp. 5-8), it is critical to investigate students' social and racial identities. Chatman et al. (2005) developed the concept of "identity content" which they described as the "substance" of the individual's answer to the question "who am I;" this substance usually contains the "individual's likes, dislikes, attitudes,

beliefs, values, ideologies, and worldviews" (p. 117). The authors (2005) drew an important distinction between the individual's personal identity and their social and racial identities (see also Brewer, 1991; Luthanen & Crocker 1992; Thoits & Virshup, 1997; Turner et al., 1987; McGuire et al., 1978; Stryker & Serpe, 1994). Personal identities are the characteristics or set of attributes that separate an individual from others, while social and racial identities are the attributes that connect the individual to others (Chatman et al., 2005, p. 118). Many scholars have suggested to forego the distinction between personal identities and collective identities because of the recursive, elusive and complex process of identity construction (e.g. Thoits & Vishup, 1997). However, Chatman et al. (2005) argued that the proposition to conflate an individual's personal identities with his/her collective identities can undermine the salience of the individual's own sense of self vis-à-vis perceived or/and established existing collective identities (p. 118).

This is particularly evident in an individual's racial identity which many have characterized as the "master" and "immutable" characteristic or classification (see McGuire et al., 1978; Stryker & Serpe, 1994). One can move up and down a social ladder or claim allegiance to different social groups over a lifetime. However, the individual cannot elude our immutable racial schema which Ibrahim (1999) defined as a *social imaginary*, a "discursive space…in which they are already constructed, imagined, and positioned" (p. 353). This is particularly salient in racial and ethnic minority groups who are more likely than dominant, majority groups to develop racial/ethnic identities shaped and informed by "their distinctiveness in their environments" (Chatman et al., 2005, p. 118; see also Crocker et al., 1994; McGuire et al., 1978;

Phinney, 1992). For instance, Ibrahim (1999), in his ethnographic study of high-school students from French speaking Senegal living in Quebec, Canada, found that those students in the process of learning English developed what the author called *Black Stylized English* (BSE). BSE is different than Black American English in that it "refers to ways of speaking that don't depend on mastery of a language. It banks more on *ritual expressions*" (p. 351; see Rampton, 1995). The students, natives of Senegal, began communicating using phrases like "*whadup,*" "*whassup,*" "*homeboy,*" "*Yo Nigga*" before achieving fluency in English. Ibrahim (1999) argued that the ESL classes that those students sat in to learn standard English became a space where to "form" and "perform" their identities in response to an already existing racial hierarchy or racial reality (see also Butler, 1990; Fanon, 1968). A reality in which those students, although from a region, nationality and culture different than that of African Americans in the U.S., are "expected to be Black, act Black and so be the marginalized Other" (p. 353; see Hall, 1991; hooks, 1992). This is echoed in Foucault's (1975/1995) *Discipline and Punish: The Birth of the Prison* where he argued that the individual's "desires" and "choices" are "disciplined" by the social imaginary under which he/she lives. Pertaining to mathematics education, black students' mathematical identities are disciplined by their racial identities within America's social imaginary, the country's racial mathematical hierarchy, and the conventional high-status identity of mathematics education which assumes that only certain students can succeed in mathematics courses (Silva et al., 1990, pp. 377-378).

This was illustrated in Martin's (2000) multi-dimensional qualitative study of students' mathematics identity formation, mathematics socialization in their classrooms and by members

of their communities and families. Martin (2000) observed that this multi-level framework allowed him to "account for both the sociohistorical and present-day mathematical experiences of African-Americans;" and it provided him a theoretical lens with which to investigate students' view of "what it means to be African-American in the context of mathematics learning" (pp. 19-21). He found that although most of the participants in his study shared similar beliefs about being black and learning mathematics, they exhibited very distinct and "complex" mathematics identities (pp. 78-79). Martin (2000) attributed this complexity to his participants varied and nonlinear mathematics socialization process at the school and community level, and their individual responses to that process. He found that for instance parents who had negative experiences with mathematics education were divided into those who merely provided *rhetorical support* to their children's own mathematical development, and other parents who were more involved and offered *substantive* and *concrete support* (p. 79). The author observed that the latter group of parents were able to develop "individual agency" that enabled them to reinvest in their mathematical development, and reconstruct a more positive mathematical identity out of a history of negative experiences in mathematics education. Martin's (2000) underlined the salience of students' racial identities, racial socialization process, mathematical experiences and their own agency in theorizing about black students' mathematical identities, and in designing intervention programs that can halt or reverse the persistence of failure among black students in mathematics.

Racial Socialization

There is disagreement among scholars concerned with cognitive and identity development as to when an individual becomes aware or conscious of the content of his/her identity and begins shaping his/her actions accordingly (Chatman et al., 2005, p. 120). Some argued that identity content isn't formed and doesn't begin to manifest into behavior until adolescence; others believed that the process begins much earlier. However, Chatman et al. (2005) remarked that, in spite of competing theories on when identity is fully formed, scholars agree that "initial identity content" is informed and shaped by the individual's parents/caregivers, family, and community (see also Bronfenbrenner, 1979, 1992; Eccles, 1993; Erikson, 1968). And as the individual matures into adolescence and adulthood, their identity content "becomes simultaneously more distinct and more blurred" (p. 120). The attributes that make up the individual's identity render their need to belong to a specific group and to be distinct from the rest of the world (including that group) more salient (Beaumeister & Leary, 1995; Brewer, 1991; Eccles & Barber, 1999; Eccles et al., 2003; Erikson, 1968; Youniss & Yates, 1997). In the case of racial/ethnic minorities, Chatman et al. (2005) argued that individuals are confronted with the "additional developmental task of considering race and ethnicity in their identity formation" (pp. 120-121). Because of their perceived differences from the majority dominant racial group, individuals from racial and ethnic backgrounds often share feelings of "marginalization" and the need to appropriate protective mechanisms "to cope with the dominant culture's [anticipated] disparaging views of their group" (Coard, Wallace, Stevenson, & Brotman, 2004).

Many studies of low, middle and high-income black families have found that implicit/explicit messages concerning racial discrimination, race-based inequity and strategies on how to fend against individual and institutional racism constituted significant aspects of child rearing. This is the process that many scholars have identified as *racial socialization* (e.g. Boykins & Toms, 1985; Hughes & Chen, 1997, 1999; Ogbu, 1981; Rotheram & Phinney, 1987; Stevenson, 1994a, 1994b; Tatum, 1987, 1997). Rotheram and Phinney (1987) described racial socialization as the "development processes by which children acquire the behaviors, perceptions, values, and attitudes of an ethnic [or racial] group, and come to see themselves and others as members of the group" (p. 17). A critical part of parenting is to equip children with skills necessary to survive particular social contexts. Generally, this signifies or results into acculturating children into specific belief systems and worldviews that not only constitute their initial identity content, but also serve to aid them navigate and negotiate their position in society. For African American parents this means "protection against racism, pride and heritage about…the black experience, and the need to succeed within mainstream [white] America" (Strauss & Cross, 2005, p. 68). This was evidenced in Oyserman and Harrison's (1998) *Implications of Cultural context: African American Identity and Possible Selves*, and Boykin and Tom's (1985*) Black Child Socialization: A Conceptual Framework*. Both studies suggested that black teenagers and young adults shared a "multifaceted identity structure" that made it possible for them to negotiate and navigate "racist situations (the world of oppression and discrimination)," "the world of African American culture," and "mainstream experiences." However, it's important to underline that many studies have found that "racial socialization does

not appear to result in the suppression of black individuality" (Cross & Fhagen-Smith, 2001; Spencer, 1995; Vandiver, Cross, Worrell & Fhagen-Smith, 2002). Spencer (1995) argued that there is an inter-connectivity and a clear distinction between black adolescents' collective racial identity and their individuality. In fact, Vandiver et al. (2002) found that the young African-American adults that participated in their study showed "considerable variability within and across" categories such as Afro-centricity, multiculturalism, belonging to or being excluded from mainstream American culture. So, the identity formation of adolescents from marginalized racial and ethnic groups are situated at the intersection of the substance of their collective racial/ethnic identity and their own "self-actualization" (Cross & Fhagen-Smith, 2001, p. 68).

In order to investigate the self-actualization or agency of racial and ethnic minority adolescents, it's critical to examine the substance of their racial socialization within the context of their lived experiences and communities. Ogbu (1981) advanced a "cultural-ecological" or cross-cultural framework with which to deconstruct and contextualize the parenting process within specific cultural and racial groups and in response to dominant cultural groups and ideologies. He argued that parenting is a socialization process "geared toward the development of instrumental competencies required for adult economic, political and social roles" (p. 413). Ogbu (1981) observed that, although adolescents across race and ethnicity share similar aspirations—for instance, they all want "money, power, social credit and self-esteem," the parenting of racial minority students often entailed the inculcation of instrumental competencies distinct from their white counterparts' experiences (pp.423-424). For instance, some of the competencies shared among black boys and girls living in socioeconomically depressed urban

communities are "self-reliance, resourcefulness, ability to manipulate people and situations, mistrust of people in authority, ability to 'fight back' or ward off attacks" (p. 424). The author stressed that another salient distinction between the upbringing of white middle-class adolescents and poor racial minority boys and girls is their differing perceptions of viable pathways to upward social mobility. Ferguson's (2000) *Bad Boys: Public Schools in the Making of Black Masculinity*, an examination of the role that public schools play in the social reproduction of racial and gender inequalities, found that the black boys interviewed for this study didn't perceive schools as a pathway to "high-status occupations." In fact, they believed that their chances of attaining success through "academic channels" were similar to their "slim to nonexistent" odds of becoming professional athletes. Similarly, Noguera (2008) found in a survey of public high-schools in North California that black boys, while overwhelmingly of the beliefs that "education is important," conceded that they didn't put in the efforts necessary to get good grades (p. 34). The author referenced another study done at a magnet school in the same region with over 500 seniors which reported similar discrepancies between black boys' "abstract articulation" of the importance of education and their "concrete" commitment to academic success (pp. 34-35; see Mickelson, 1990). Noguera (2008) observed that the gap between abstract and concrete beliefs about the value of education can be attributed to the schooling experiences of many black boys for whom, schools, rather than "serving as a source of hope and opportunity…are sites where [they] are marginalized and stigmatized." (p. 22).

Students Stereotyped as Low Ability

Many cognitive psychologists have underscored the impact of students' perception of an "academic domain" on both their engagement level and performance in the classroom (e.g. Aronson, Quinn, & Spencer, 1998; Lawrence, Crocker, & Dweck, 2001; Steele, 1997; Steele, Spencer, & Aronson, 2002). For students from social and/or racial groups that have historically been categorized as low-ability or failing in a particular academic subject, classroom activities such as asking for help, participating in class discussions, feedback from teachers can "take on ominous meaning" (Lawrence et al., 2001, p. 25). These activities can pose a threat to those students who may interpret common classroom practices like asking for help, answering a question aloud incorrectly, or doing poorly in an assessment as risks of "confirm[ing] the low-ability stereotype about their group" (p. 25). Scholars have referred to these processes as *stereotype threat* (e.g. Steele, 1997; Steele et al., 2002). Steele (1997) defined the concept of stereotype threat as the "aversion" or negative thoughts harbored by "members of any group about whom a negative stereotype exists;" these thoughts can shape stereotyped individuals' perceptions of specific social contexts and experiences (p. 614).

Stereotype threat is "situational" in that it is continuously being shaped, affirmed and challenged by every situation (Steele, 1997). Spencer, Steele and Quinn (1997) found that women and African American students, stereotyped as low-performing in mathematics, experienced significant level of emotional distress and pressure when taking standardized mathematics tests. And for many of those students, the emotional distress and pressure

negatively affected their performance and test scores (Spencer et al., 1997; see also Steele & Aronson, 1995). Moreover, Steele (1997) observed that stereotype threat experienced in a particular domain over a continuous length of time can pressure stereotyped individuals into *disidentification*; that is to dis-identify with or dissociate from a "domain" as a self-identification and self-actualization process (pp. 614-615).

This was evidenced in Martin's (2000) study of black middle-school aged students who attended a school that had adopted Robert Moses' *Algebra Project*. As previously discussed, the Algebra Project's aim was to enroll more black middle school students in algebra courses and to build mathematics curricula and instructions based on students' lived experiences. Martin (2000) found that the majority of students observed in this study demonstrated very little interest in this new way of doing mathematics because they "had spent the previous 6 years of their lives doing mathematics in a more or less traditional way" and had "developed certain expectations" (p. 178). The author's multi-level analysis and framework demonstrated that students stereotyped as low-ability in mathematics dis-identified with mathematics as a domain, developed over time an expectation of what constituted "real mathematics" and an identity that mathematics content and knowledge "are not important" to their present and future lives (p. 176). Martin (2000) argued that students' mathematics identity shaped by years of failure and negative experiences with mathematics education made it difficult for them to experience mathematics 'grounded in their real life experiences' meaningfully and differently. This is what Steele (1997) characterized as a form of protective or coping mechanism whereby individuals stereotyped in a domain find "retreat in not caring about the domain in relation to the self" (p. 614).

Steele (1997) remarked that the process of disidentification can have negative effects even on stereotyped individuals who possess the "skills and self-confidence to have identified with the domain" (p. 615). The problem, he argued, is that individuals from social or racial groups characterized as low-ability in a particular domain and who "remained identified with [the] domain" will experience sustained threats and obstacles to their continued "identification with the domain" (pp. 615-617). Such individuals' identification with a domain is seldom fixed; it requires on going justification and reaffirmation. Thus, students from social groups stereotyped as low ability or as failure in mathematics education, tend to view mathematics classrooms and activities as ominous and risky; every mathematics classroom and every mathematical task is a threat confirming or refuting their inferiority in the domain of mathematics.

High-performing students from social or racial backgrounds characterized as inferior academically tend to "include achievement as a central part of their self-concept" (Lawrence, Crocker, & Dweck, 2001, p. 32; see also Gollwitzer, 1996; Steele, 1997). Such students are often termed *academically identified* and tend to be more susceptible to stereotype threats than other students stereotyped as low-ability. One of the reasons is that academically identified students are "perpetually motivated to validate" their identification with specific academic domains (p. 32; see also Stryker, 1968). Consequently, such students are more likely than non-stereotyped and non-academically identified students to under-perform in tests or performance-tasks that purport to assess ability. One of the reasons is that for academically identified students from social backgrounds stereotyped as academically inferior, poor performances in diagnostic

assessments "challenge [their academic identity] and are therefore highly disturbing and disruptive" (Lawrence et al., 2001, p. 33; see also Marx, Brown & Steele, 1999; Steele, 1997).

Conceptual Framework

Performance in mathematics is viewed by many scholars in the field as "participation in a social ecology" (Darragh, 2013, p. 216; see also Bowler, William & Brown, 2000; Esmonde, 2009; Lerman, 2009). Students' success or failure in mathematics is interpreted as a process of inclusion or exclusion from the mathematics community created in the classroom. In this paradigm, studies concerned with developing deeper and more nuanced understanding of race-based performance in mathematics education focused on students' membership to the academic domain instead of simply looking at cognition and pedagogies (Darragh, 2013, p. 217). Moreover, mathematics classrooms are conceived as what Holland, Lachicotte, Skinner and Cain (1998) coined *figured worlds*, "socially produced and culturally constituted activities" (pp. 40-41) where students shape, develop and perform their mathematics identities and sense of belongingness. Urrieta (2007) described figured worlds as "sites where identities are produced" and reproduced; thus, math classrooms are sites where students "figure" whether they belong through classroom "activities" and "in relation to the social types that populate these figured worlds" (p. 108).

In this construction of mathematics education and learning, the notion of confidence is distinguished from self-efficacy, and constitutes a subset of identity. Hardy (2007) argued that confidence "brings with it reference to social practices" and elicits the need to examine the "relationship between individual subjects and [their social realities] implicit" in their experiences

of learning mathematics (p. 23). She borrowed from Foucault's (1982) concept of *subjectivity*, "a subject is both agent and subjected to," to explain that confidence in an academic domain is not fixed but rather a "process through which learners…are constituted…and constitute themselves" (pp. 23-24). Similarly, Varelas, Martin and Kane (2012) underscored the importance of conceptualizing mathematics learning as "a process involving content learning (CL) *and* identity construction (IC)" (p. 319). The authors argued that CL and IC are both involved and needed in investigating students' sense of belonging to an academic domain and construction of a particular academic identity. In order to provide insights into black students' history of failure in mathematics education, Valeras et al. focused on the intersection of those students' "*disciplinary* identity (as doers of a discipline)," "racial identity (emerging understandings of what it means to be Black)," and "academic identity (as participants in academic tasks and classroom practices)" (p. 319). In fact, the authors argued that black students' mathematics identity (confidence or anxiety) is constructed and shaped by their ability to:

> negotiate their identities not only as…doers of mathematics…in the context of their classroom practices, but also as members of a social group whose racial identity is salient and often subject to negative characterizations in schools and in other societal contexts (p. 335).

Thus, initiatives and studies concerned with gaining greater understanding the under representation of black students in higher level mathematics courses need to focus on the

"identity work that students do in conjunction with learning the content of [the] discipline" (p. 336).

An illustration of learning conceptualized as a complex and recursive combination of content learning and identity construction is Goldblatt's (1995) *'Round My Way: Authority and Double-Consciousness in Three Urban High School Writers*. The author demonstrated how "the institutional codes and procedures" that govern academic writing positioned racially and socially marginalized students at a disadvantage and forced them to choose between their "private selves" and academic success (p. 151; see also Ferguson, 2000; Noguera, 2008). He (1995) argued that such students are "by definition those whose private selves are at odds with the dominant view of a proper public persona" (p. 152). The reason, he observed, is that students from privileged backgrounds typically "learn a discourse at home and in the neighborhood" that is compatible with academic institutions' expectations while students from under-resourced communities "must accommodate themselves to multiple authoritative discourses" that are often in contradiction (p. 155; see also Bahktin, 1981; Holquist, 1982). This often creates a tension between students' private and public selves (p. 153). This can lead students to perceive their private selves as hindrance to their academic development and success which will subsequently cause them to either disengage with schooling or attempt to "blot out their private selves in order to gain some modicum of public acceptance" (p. 152; see Dubois, 1903/1989).

In light of this, this study seeks to investigate the mathematics confidence of black students within the context of what Martin (2009) called the *racial hierarchy of mathematics ability* in America. Martin (2009) argued that the extant literature in mathematics education

suggests that there exists a race-based hierarchy of mathematics ability that "positions…African Americans, Latinos, and Native Americans at the bottom," and Whites and Asians on top (p. 297). Moreover, policy and program initiatives aimed at closing the race-based achievement gap "carry with them the assumptions of the inferiority" of those students (p. 298). Those initiatives seem to locate the persistence of the academic failure of black students in mathematics education in the content of their personal selves, their racial, sociocultural identities. In other words, for black students to "become 'more proficient' and 'high-achievers,' they must become…more like White and Asian students in terms of their dispositions and values" (p. 298).

This study makes use of Valeras et al.'s (2012) *disciplinary* identity, *racial* identity, and *academic* identity as a framework with which to analyze black students' mathematics confidence, its relationship to their accumulated experiences with learning mathematics and their view of the purpose of mathematics in their lives. The content of students' racial identity, their perceived social position and responsibility provide insights on how they negotiate being stereotyped as low-ability in a discipline that has become one of their most viable paths to economic opportunities and upward social mobility (Alquist, 2001; Catsambis & Beveridge, 2001; Freitas, 2008; Pelavin & Kane, 1990; Tate, 1994). Black students are tasked with the challenge of merging their (consciousness of) belonging to a group stereotyped as mathematically inferior with needing to succeed in mathematics in order to be able to compete in today's job market.

CHAPTER 3

METHODOLOGY

The extant literature concerned with race-based achievement gap in mathematics education tends to compare black students' performance to their white and Asian counterparts in order to advance theories and provide insights about differential academic outcomes (e.g. Johnson, 1984; Lubienski, 2002; Martin, 2007b, 2009a, 2009d, 2009e, 2012; Secada, 1992; Strutchens & Silver, 2000; Tate, 1997). A disproportionate number of those studies have focused on low achieving black students and the factors responsible for their failure in mathematics classrooms. Subsequently, a review of the literature in the field of mathematics education showed a dearth in the scholarship on high achieving black students, their experiences, perception of, and identification with the academic domain. Martin (2012) underlined this fact and asserted that researchers in the field of mathematics needed to focus more attention on "stories of high achieving black students who have productively climbed the mathematics ladder" (p. 49).

In light of this, this study, using ethnographic methods, sought to investigate the mathematics confidence, a subset of mathematics identity, of 11 black students enrolled in honor's pre-calculus at Oxford High School. All the participants, at the beginning of this study, had already spent at least two of their four years at Oxford, a comprehensive secondary school in the district of Philadelphia. Many of seniors in the honor's pre-calculus class had been in the

same math classes for most of their high school years. In fact, 6 out of the 11 seniors selected for this study, were part of the honor's Algebra II class their junior year.

The College Pipeline Program

This was part of an ongoing and larger study sponsored by the renowned accounting firm E&Y in partnership with Cecil B. University. One of this partnership's main goals is to increase the number of Oxford students graduating high school with the mathematics and reading skills necessary to avoid being placed in remedial college mathematics and English courses. E&Y funds the college pipeline program and Cecil B. University's faculty members and doctoral students are recruited as researchers, program coordinators, supervisors and facilitators. Student teachers, fourth year undergraduates from Cecil B. University's education department, are also brought on to help with the implementation of the program's math and English curricula while also fulfilling their fieldwork requirements for graduation. Student teaching follows the academic calendar of Cecil B. University and student teachers are expected to work with the program for an entire college semester. Doctoral students' tenure with the program begin in the summer and is expected to last until the end of the Philadelphia school district's academic year.

This initiative began in the spring of 2013 where Oxford juniors and seniors were offered after-school classes and tutoring in essay writing and mathematics at Cecil B. University at least twice a week. However, due to logistical issues such as transportation and attendance, coupled with programmatic problems such as quantifying and measuring students' academic growth and college readiness, the initiative switched from an off-site model to an enrichment academic

program offered at Oxford to a selected group of juniors and seniors. Juniors and seniors recruited into the program were required to take, in a same academic year, one honor's math and one honor's English class. Each honor's class' curriculum was designed by a team of Cecil B. University's faculty member, doctoral student and an Oxford teacher. At the beginning of this study, 27 juniors and 31 seniors were enrolled in E&Y and Cecil B. University's honor's college readiness program. Most of those students were taking honor's Algebra II or honor's pre-calculus and honor's English. These classes were taught by a lead teacher and student teacher assisted several times a week by a Cecil B. University's doctoral student.

Overview of study

This study was conducted concurrently with the E&Y and Cecil B. University's college pipeline program at Oxford. The 11 participants selected for this study were enrolled in honor's pre-calculus and English for the entirety of this study. They were, like the other seniors in that class, offered extra-curricular services like mentoring, college essay help, guidance and support in navigating the college application process. Students in the E&Y and Cecil B University's college pipeline program were selected based on recommendations from teachers and principals, overall grade point average, attendance history, and students' overall in class/in school behavior.

The unit of observation for this study was Oxford's 2015-2016 senior's class. As stated above, the students who made up the class were all selected based on their past academic achievements, good overall attendance and behavior. Many of whom were recruited into the E&Y and Cecil B. University's college pipeline program as juniors; thus, most of the class had

been together and enrolled in honor's mathematics for at least a year prior to the beginning of this study. I was introduced to the senior's class—they were still juniors then—and Oxford High School in June of 2015, a few weeks before the end of the academic year. The introduction was facilitated by the former, then exiting, doctoral student on the project. I began working with the senior's class the first day of the 2015-2016 academic year.

My primary responsibilities ranged from facilitating workshops for student teachers, developing academic curricula for the honor's Algebra II and pre-calculus classes, collaborating with Cecil B University faculty member and Oxford math teacher on devising programmatic and logistical plans in order to maximize students' learning opportunities and growth. The bulk of this work took place during the summer month preceding the start of the academic year. During the academic year, most of my duties revolved around creating weekly lesson plans under the supervision of a Cecil B University's faculty member, modeling and ensuring faithful implementations of those lessons, supporting student teachers' growth, and deepening students understanding of mathematical concepts/tasks during small groups or independent work time.

During the majority of this study, I had to continually work on balancing my responsibilities to the E&Y and Cecil B. University's college pipeline program and fulfill my role as a researcher conducting an ethnographic study of students' perception and confidence in mathematics. I played a significant role in shaping seniors experiences with honor's pre-calculus in the classroom. Moreover, I spent 10 months witnessing and living alongside them some of the benefits and frustrations inherent to teaching and learning mathematics, particularly as it pertains to the domain's more abstract and sophisticated concepts. My contribution and participation in

how the seniors experienced pre-calculus coupled with my 10-month long observations and documentation of their views and identification with mathematics is an illustration of trying to fulfil the dual *participant-observer* role. Meaning, for this study I was an observer who collected copious notes on students' views, attitudes toward and responses to mathematical tasks and instructions, while also joining in their struggles and successes working on daily activities. This is believed to be a requirement for ethnographic studies interested in advancing theories and deepening understanding of social realities and phenomena "from the perspectives of participants" (Mertens, 2015, p. 243). Because ethnography's focus is on "human, society and culture," ethnographic studies require "sustained engagement" with the group being studied (Mertens, 2015; Merriam 2009). The researcher, in order to advance any meaningful knowledge about a group's cultural and social reality, must be completely immersed in the participants' world.

One of the central tenets of ethnography and other qualitative studies is uncovering and providing insights about preconceived assumptions about people's life-worlds. In the case of black students and mathematics education, Martin (2012) observed that the mainstream perception is that of "failure as normative" or expected (p. 48). Thus, this ethnographic study of a group of seniors in an honor's pre-calculus class, sought to challenge mainstream beliefs about black students and mathematics by constructing a narrative based on students' individual experiences, interpretation of those experiences, and identity construction as a result of their perception of the meaning of learning and doing mathematics.

Fall of 2015

During the months of September to December, I visited Oxford high school at least twice a week, on Tuesdays and Thursdays. The honor's Algebra II and pre-calculus classes were students' last two periods of the school day which began at around 1:05 pm and 2:55 pm respectively. I usually arrived at the school at about 12:30 pm, more than a half-hour before the junior's honor's Algebra II. Often, I would find Ms. Turner, a white woman in her late fifties to early sixties, the math teacher for the juniors and seniors from the college pipeline, finishing up her lunch break. Either in her own classroom, or in the classroom next door—Mr. P's room—she was almost always seated at a student's desk, empty food containers and plastic bags piled up atop the desk. In the beginning of the academic year, Ms. Turner was mostly in Mr. P's room, along with other Oxford's teachers and Mr. Bond, the student teacher, engaged in light hearted school and non-school related gossips. As soon as I arrived, she would gather her stuff and walked me next door to her classroom. Once there, conversations were more school-centered; however, they still ranged from the latest news about a particular student's home life or in class misconduct, new school policies, recent rumors, an in school fight, and upcoming holidays or scheduling changes.

By my second or third week, it was evident that, in order to use those thirty plus minutes before the juniors' Algebra II honor's class more constructively, I had to learn how to focus and redirect our conversations to the mathematics that the college pipeline students were expected to learn and perform. Since I was responsible to make and provide copies of homework, classwork and other materials students were supposed to use in a given week, I decided to dedicate the first

few minutes of my convening with Ms. Turner and Mr. Bond on organizing the hundreds of pages of math materials. Then, we would transition into the day's lessons and students practice work. Ms. Turner would typically not opine or ask any questions about the 11th and 12th grade lessons scheduled for that day. If there were any concerns or confusion about a particular lesson or task, it was brought to my attention by the student teacher, Mr. Bond. This was also a time that individual students, some from the college pipeline program and others from Ms. Turner's earlier regular math classes, would come in to either collect late work or announce that they were going to be absent.

Once the bell rang for the juniors to come in, I would walk to a corner somewhere in the back of the classroom with a pen and a notepad. At the beginning of this study, I was intent on being as much of a 'fly on the wall' as possible in order to observe, absorb and document everything on how students stereotyped as low performing view and identify with mathematics in the context of an honor's pre-calculus class and the many extra-curricular services offered to them by the E&Y and Cecil B University's college pipeline program. However, early in the study, it became clear to me that it was impractical and likely unethical to fully subscribe to the dispassionate and detached researcher identity in a classroom of mostly hardworking and high performing students struggling to make sense of certain mathematical concepts and strategies. Thus, I was often working with small groups and individual students during independent work time or when Ms. Turner or Mr. Bond was in front of the class modeling a strategy that posed difficulty to some juniors or seniors. Also, I interjected frequently during Ms. Turner and Mr. Bond's teaching particularly when I deemed it necessary to underline a point that was

overlooked or presented incorrectly. Within a couple of weeks, there were a handful of juniors and seniors who actually expected me to sit with them during part of the class. Others were vocal about the fact that they preferred my 'way of teaching' over Ms. Turner's or Mr. Bond's. In fact, a few of the highest performing juniors and seniors frequently called me over to show or ask me for a new or "cooler" method of solving a problem.

The first couple of months of this study were challenging because I was convinced that I was spending too much time teaching, working with students, and not enough as an observer. The month of September was certainly the most challenging. The papal visit[1] at the end of the month caused an additional 3 to 4 days of school closure to a month which already has a handful holidays scheduled in the academic calendar. For me, it made building a rapport with some students much harder because I could only see them once a week and at times not at all for a significant stretch of time. Moreover, the many interruptions to the school week complicated my struggles with balancing my researcher and facilitator role. I left Oxford many times during the month of September frustrated and anxious that I was not collecting enough data on how high achieving black students conceive of and identify with mathematics.

Fortunately, the month of October only had one official holiday. By then, I had devised a few plans to improve my data collection process without necessarily having to compromise my role as a facilitator and at times teacher. I had used the few days in September to identify

[1] All Philadelphia public schools and administrative offices will be closed Monday, Sept. 28 due to the Papal visit, according to the Philadelphia School District. Philadelphia public schools will also be closed Wednesday, Sept. 23 for Yom Kippur and Thursday and Friday, Sept. 24-25 for the Papal visit (http://www.nbcphiladelphia.com/news/local/Schools-Closure-Pope-Visit-Philadelphia--328575801.html)

moments where it made sense or was easier for me to be a fly on the wall, observe and document. Those were mostly during the first 10-15 minutes of class where students were often quietly working on a "do now" or rummaging through their backpacks for homework that was being collected or graded for completion. Over time, I began using this time to focus my observation on some recurring occurrences like the number of students on time and on task, whether Ms. Turner was prepared to begin the lesson on time, the inconsistencies in her dealing with lateness and late homework, students' instincts about a concept and their general feelings about having to be in a mathematics classroom the last couple of periods of a school day.

This was also a great time to listen in and make note of students' side conversations about aspects of their lives unrelated to academics. Toward the end of the month, I was brought into some of those conversations more and more. For instance, Felix, one of the seniors who participated in this study, started asking for my thoughts on the latest sports headlines. Similarly, but far less frequently, Stephanie, another participant in the study who usually finished her 'do now' ahead of everyone else, would call me over to ask about college and the practicality of majoring in performing arts—this started after she and I had a conversation about college, her passion for dance and acting and the fact that my undergraduate degree is in Theatre and Speech. This was also true with the juniors' class; however, the side conversations were mostly about their social lives except the few times a student-athlete wanted to inquire about sports scholarships or explain to me why they didn't plan on applying to any Division 1 schools. It got to a point that I began entering certain side conversations, mostly on sports, without feeling that I needed to wait for a verbal invitation. Other times, students would seek out my input on certain

conversations like ‘is Stephen Curry better than Lebron James?.’ These side conversations had already begun prior to class, and were often just continuing in the first few minutes of the period. They were almost always cut short. Occasionally, a conversation would resurface after the bell rang the end of the period.

Thus, finding moments to be the dispassionate observer resulted into my being brought into the lives and world of some students outside of Algebra II or pre-calculus. It forced me to realize that instead of fighting to separate moments where I could be an observer and moments where I needed to be a participant, it was more conducive to an ethnographic study of students’ mathematics perception and identification to document “from the inside” (Emerson, Fretz, & Shaw, 1995, p. 2). In other words, it became clearer to me that whether sitting in the back of the room observing, or working with a student on a math problem or being pulled into a conversation about the difference between flirting and cheating, “The ethnographer[’s role is to] seek deeper immersion in others’ worlds in order to grasp what they experience as meaningful and important” (p. 2). So, I was less frustrated after a whole class period spent on helping students and teaching; likewise, I ceased to think of moments when I was summoned to be the arbiter of a debate unrelated to mathematics as wasteful. Instead, my notepads and pen always readily accessible, I began to understand that every moment contained the potential “to describe and provide an analytical framework…” necessary to “uncover an important ‘truth’ about a phenomenon of consequence” (Horvat, Heron, Agbenyega, & Bergey, 2013, p. 20). For me, this meant that every moment could help to elucidate how students stereotyped as low performing view and identify with mathematics in the context of an honor’s pre-calculus class and the many

extra-curricular services offered to them by the E&Y and Cecil B University's college pipeline program.

To ensure that I was fully immersed in and not missed to document a moment, I bought myself one of those eight-pocket folders. Inside the folder were always three to four pens, several miniature notepads along with other materials like lesson plans, worksheets and class lists. I almost never parted with the folder except for when I was teaching the whole class or when I was checking in with Oxford's security guards by the school's entryway. Otherwise, the folder was with me and was often used as support for writing in my notepad. When I had to work with individual or group of students, the folder was either on an adjacent student's desk or on the floor near my feet. I learned to keep the notepad that I was taking notes in open on the page where I jotted my last notes or thoughts. This way, while working with a student or a group, I could easily and quickly jot something down in my pad the second my assistance was no longer required. It was also helpful to have the folder with me when I was finished working with a group or engaging in a side conversation because I could recede to a corner of the room and document inconspicuously what just took place.

By the middle of November, I was using my note-taking tactic during my regular meetings with Ms. Turner and Mr. Bond before class and even during some of our impromptu meetings after dismissal. This was often a great opportunity for me to get the inside scoop on Oxford's teaching staff, administrators and students. For instance, during a meeting on coming up with more effective ways to grade and collect students' homework, Ms. Turner redirected the conversation on a rumor about the school's principal who was apparently working on his

doctoral studies and was struggling balancing his many responsibilities as a school leader with that of a graduate student. I took advantage of the times when our meetings went off track to record information—they were mostly unrelated to academics—about students, the school's staff, teachers' beliefs and attitudes towards students, and the neighboring community. It was during those meetings that I learned from Ms. Turner, that some of the students in the college pipeline program were experiencing issues ranging from sexual abuse, violence, homelessness, food insecurity, and mild to severe mental health problems.

By then, a day's field notes, after being fleshed out, averaged 6 to 8 single-spaced and typed pages. Because of the amount of information that I was recording and my somewhat discreet method of collecting data, most of my notes were abbreviated and illegible. At times, some notes were scribbled in between two other unrelated truncated phrases or sentences. So, the first phase of fleshing out and untangling my notes began right after dismissal, in my car. I usually parked on a wide, mostly quiet one-way residential street with no parking restrictions. It was perpendicular to the two-way and narrower street that Oxford's entrance was on. This turned out to be ideal because it was far enough from the school and any of the students' and teachers' curious gazes; moreover, I was parked on a street that didn't typically see much foot traffic. After school lets out, I usually sat in my car for 30 minutes to an hour reading over, clarifying and expanding upon my notes for the day.

Looking back now, November was the beginning of when I began understanding and embracing my role as a participant-observer. I certainly felt less pressure to find a balance

between my researcher and facilitator roles; I was more concerned with being in the moment, being attentive, and "getting close" (Emerson, Fretz, & Shaw, 1995, p. 1).

Spring of 2016

The first day back in January of 2016, following the end of year holidays, I was focused on finding seniors willing to participate in this study. Early onto the year, I was able to visit Oxford 3 to 4 times a week because the college academic semester hadn't begun yet. Even after I resumed my college teaching duties at other colleges, I was able to arrange my schedule so that I could go to Oxford on Mondays, Wednesdays and Fridays instead of the two times a week from the previous semester. I used that time to schedule and conference with a number of seniors after class, or during independent practice time and even sometimes during other parts of a lesson about potentially becoming key informants for this study. Many said that they would and wanted to know if I were going to ask the same questions they were asked last year during their junior year.

As mentioned earlier, many of the seniors enrolled into the college pipeline program and honor's pre-calculus were also part of the program and honor's Algebra II their junior year. Oxford students from the college pipeline program were invited to participate in a study conducted by Cecil B. University's faculty members and doctoral candidates who measured the impact of the program on students' reading/writing and mathematical skills. Students' academic gains are reassessed every academic year using interviews, pre and post-tests. So, many of the seniors in the pre-calculus class were interviewed the previous year and were administered and pre and post-test.

This study was running concurrently with E&Y and Cecil B. University's college pipeline and research program. Because I was a student investigator on the project and received a partial research assistantship for my services, I was able to make use of the project's existing IRB proposal with some minor amendments. I was also given full access to students' academic history, in class work, assessments, and attendance. This information was used along with a Likert scale's *Survey on Mathematics Confidence* (Appendix C) to identify this study's Key Informants. The goal was to select a purposeful representative sample of the seniors' honor's pre-calculus class in terms of achievement and confidence levels.

This study only made use of data collected from observing and interviewing seniors from the college pipeline program because one of the project's key questions is based on students' accumulated experiences with K to 12 mathematics, their perception of the academic domain, and its potential impact on their envisioned lives. So, the *Survey on Mathematics Confidence* was only administered to seniors. There were 10 items or questions and for each one, students could choose between "1-= Confident;" "2 = Somewhat Confident;" "3 = A Little Confident;" and "4 = Not Confident." Students' raw scores were calculating by adding up the number of questions for which they checked "confident" or "somewhat confident." Students' confidence levels were tabulated in percentages. The results from the survey were triangulated against students' academic history in high-school mathematics, their performance and overall grades in honor's pre-calculus, Ms. Turner's insights on students' ability, and my observations and notes on students from the beginning of the academic year until then. A group of about 16 seniors were identified initially for this study.

The first couple of weeks in January were scheduled for Oxford students to take or re-take the Keystone Exams and AP exams. There were a few days where the school's schedule was such that the juniors and seniors didn't have their afternoon classes or only had their last few class periods. On most of those days, attendance across the whole school was very poor in the afternoon because students who had an exam earlier that day decided to go or stay home after the exam. Even though most of the seniors had really taken their Keystone Exams or didn't need the exams for graduation, many of them decided to stay home or leave school early during those days. However, even on days that more than half the seniors were present, Ms. Turner sometime chose not to start a new lesson for fear that she would have to repeat it the next day. So, at times, I was able to conference with seniors during class time about the study's particulars and their interests in it. Those conferences were usually held outside of the classroom, in a quiet enough corner, in the hallway.

However, because of poor attendance and a few seniors uninterested or uncomfortable with being interviewed, only 11 participants were recruited as key informants for the project. Attendance was a critical criterion for me because I wanted to recruit students whom I thought of as reliable and who have been showing up to class with some regularity. Also, it was important for me to recruit seniors who self-identified as Black or African-American, and with whom I had established some sort of a rapport. Participants who were under 18 years of age at this stage of the study had to fill out an *Informed Consent: Assent for Participants Under 18* (Appendix D) and have their parents or legal guardians fill out an *Informed Consent: Parent Permission Form* (Appendix E). Others who were 18 or older filled out an *Informed Consent: Assent for*

Participants 18 or Older (Appendix F). The 11 participants selected were categorized as: "1. High Ability & High Confidence;" "2. High Ability & Low Confidence;" "3. Low Ability & High Confidence;" "4. Low Ability & Low Confidence."

Table 3.1 Ability-Confidence Categories

	High Ability	**Low Ability**
High Confidence	Kawhi, Weldon, Nigel	Andre, Tyronne, Felix
Low Confidence	Tamika, Stephanie, Shalik	Kendrick, Victor

I continued refining balancing my *participant-observer* role; however, more of my attention was focused on the study's key informants. The three days a week that I was at Oxford, my time was now divided between teaching at times, facilitating whole group or small group discussion, observing the study's participants, and seizing every opportunity to engage them.

The end of the month of January and the beginning of February marked the beginning of focusing my field observations and notes on this study's key informants. I was growing less concerned with 'vacuuming' every interaction, every conversation related or unrelated to honor's pre-calculus, every piece of gossip from students or Ms. Turner, and more interested in gathering as much information needed to develop a profile for each participant. It became critical for me to learn as much as possible about the teenage boys and girls that I was going to interview to ensure that I was capturing or at least attempt to highlight how participants interpreted their experiences in K to 12 math classrooms differently/similarly. This study examined students' perception of and identification with mathematics; thus, I argue that it was important for me to understand the

individuals who elected to be part of this study, the relationships they formed in the classroom (and outside the classroom), their passions, their views and fears of the world, and their aspirations.

I began paying attention to those participants' patterns of absences and lateness. For instance, I noticed that most of the time, if Shalik was late or absent, Stephanie was also not there. I found out from Ms. Turner and from talking to both students that they were dancers and often had rehearsals in the school. From what Stephanie told me, she and Shalik were forced to miss or come late to class every now and again because they were preparing for an upcoming show. I didn't get a chance to see Stephanie and Shalik dance live but they showed me a video recording of them rehearsing. Ms. Turner, on at least five separate instances that I documented, wanted Shalik and Stephanie to demonstrate some of their performance skills to me and other seniors who were lingering behind after the bell rang. The two students also were almost always seated next to each other and collaborated nicely during independent work time. They were among the highest performing seniors in the honor's pre-calculus class. However, they were among the first voices you would hear complaining about not knowing or recalling how to solve a problem. In fact, this became our inside joke because Shalik was quick to say "I don't know this" and then raised his hand three minutes later to show the class how he solved the problem.

Similarly, Weldon and Tamika appeared to be good friends outside of class and often missed or were late to class together. Weldon missed classes more often than Tamika did; however, I found out that Weldon drove Tamika to school in the morning and to work after school. The two of them also had a great working relationship. They were also hard workers and

high achievers. Weldon and Tamika were recruited into the college pipeline program as juniors and apparently have known each other for much longer. Ms. Turner wasn't shy about how highly she thought of the two students and how confident she was that they were likely to lead very successful college and professional lives.

Ms. Turner did not feel the same way about Andre and Nigel who also appeared to know a lot about each other's life outside of pre-calculus. The two seniors were amongst the students with the most lateness. Nevertheless, they were rarely absent. I don't recall ever witnessing Andre and Nigel at their desks on time. It was either that Andre was one of the first seniors in or that Nigel rushed in right before the bell marking the beginning of the period rang. The two students usually sat in the back of the class, next to each other. Randomly, Ms. Turner would force Andre to move to the front of the class so that he could pay attention. He always complied; at times reluctantly, but Andre, one of the shortest and smaller-framed male seniors in the class, never failed to get up from his seat next to Nigel for an empty desk in the front row. Strangely enough, Ms. Turner never asked Nigel, one of Oxford's former football starters, to move his seat. Ms. Turner had told me on three separate occasions that although Andre and Nigel were high ability students—Nigel used to be a straight A student up until his senior year—she was concerned about the students' future. She particularly worried about Andre whom she described as "a follower" who followed the wrong crowd. Ms. Turner told me that Nigel was more of a "leader" and had a better chance at college and professional success if he decided to cut ties with some of the friends he hang out with. She usually reiterated her concerns and views of both students after Nigel and Andre came in very late to class or rushed to leave before the bell rang:

> Ms. Turner said that Andre was involved in selling drugs and with the wrong crowd because he was trying to compensate for his size and small frame. She said that he had a "Napoleon complex." Ms. Turner continued and said that she believed that Nigel can make it out of Oxford and out of the life of dealing drugs and that he was a leader. She believes that Nigel will be just fine if he gets himself into a college away from Oxford—it is worth noting that Nigel is already accepted into Shippensburg University of Pennsylvania. She is not confident that Andre will make it because he's a follower (field notes, Mon 03/28/16).

During that exchange, I asked for evidence or reasons beyond the two students coming late to class or leaving early that would substantiate her claims:

> Ms. Turner's evidence that Nigel was selling drugs was Nigel's family and circle of friends. She pointed out to…in spite the fact that "his family is stable," the circle of friends that he walked around with are trouble. She provided no specifics or concrete examples of why she thought Nigel's friends were involved in drugs (field notes, Mon 03/28/16).

By that point in the study Ms. Turner and I had exchanged information about our more personal lives. She confided in me during one of those meetings before class that she did not have children because her ex-husband, a struggling drug addict, did not want kids. I told her about my growing up without a father and how painful the sight of a father interacting with his son can be at times. So, that day, when it seemed like she wasn't going to provide any concrete evidence, or attempt to reconcile Nigel being from a "stable" family and selling drugs, I felt comfortable

challenging her. By the time of this study, Ms. Turner had been Nigel's math teacher for most of his high school life and thought very highly of his mathematics skills and potential. She also never failed to mention, in most conversations about Nigel, that he used to be a straight A student. Thus, it was puzzling to me and worth underlining in my notes Ms. Turner's competing views of a student whom she thought of as academically gifted and running an illegal drug operation.

Moments like these helped elucidate and contextualize candid commentaries from students. For instance, it helped me understand Nigel's frustrations with feeling that he had to prove that he was smart and not a "street person." It took a while before Nigel and I really talked. At the beginning of this study, he always refused help from me. It did not matter if he was struggling with a particular problem or that he wasn't in the mood, he would rather wait until Ms. Turner could get to him. I asked him about it one day and he said that it is because I probably thought that he was "dumb." Nigel did not provide any explanation for why he felt that way; nor was he able to recall any moment where I said or did something that implied he was dumb. However, after he and I became closer—Nigel and I joked often about how "corny" I dressed or how he didn't need to cut his hair every week—he shared with me stories about Oxford teachers who questioned his being in an honor's class or had jokingly referred to him as "gangster." I was never clear how offended he was by teachers' disparaging views of him, but it was evident that he wanted to understand.

Focusing my attention on key informants and developing more organic relationships with them not only clued me into their lives outside of pre-calculus, it helped me begin piecing

together their relationship to mathematics. Early on into this study, the majority of the seniors did not appear to want be in class. Some were in fact often vocal about it; however, when prompted, they never said more than the usual "I don't wanna be here," "this is boring" or "I don't like math." This was disconcerting to me at first. It didn't make sense to me that an honor's pre-calculus class of 30 seniors all felt similarly about math. Not until I got closer to some of the seniors that they would begin to expand upon or explain how their accumulated experiences in math classrooms have shaped their perception and relationship to the discipline. For Shalik and Stephanie, among the first seniors to complete a task successfully or volunteered to demonstrate to the class how to solve a problem, mathematics was "not supposed to make sense." Stephanie, while I was working with her simplifying a rational expression with a complex number at the denominator (like for example: $\frac{x-2}{3x-i}$), she told me that she understood how to solve the problem but had trouble understanding where these rules came from and why she had to know about them. At a later time, while helping her during independent practice, Stephanie said that she never conceived of herself as a *math person* because she wasn't confident that she could remember all the rules and that as a high school student, she could never get herself to do math outside of the classroom. This was the reason that she was so attentive and worked so hard in class because she knew that was her only opportunity to learn and practice the rules.

Getting closer to seniors selected for this study provided me with valuable insights on their relationship to mathematics and served as a guide to points or issues to raise with each participant during their first round of interviews. Around the end of February and the beginning

of March, I started planning the study's first round of interviews. Ms. Turner was gracious enough to allow me to pull students out during class and to use her office space down the hall from the classroom. Interviews were carefully scheduled so that students did not miss the introduction to a new mathematical concept or an in class assessment. So, days when Ms. Turner planned to review a topic or review for an upcoming assessment were generally ideal times to interview students. The last 20-25 minutes of class were also good for interviewing high performing students like Kawhi, Weldon and Tamika who typically needed very little assistance in learning and working with a new concept. For other participants, like Tyronne or Kendrick, who struggled during most of their senior year in honor's pre-calculus, I would spend time with them going over mathematical concepts and their applications before beginning the interview. For the first round of interviews, the shortest interview, Felix's, was just under 20 minutes long and Kawhi's interview, the longest, was over 41 minutes.

As I was scheduling individual seniors for their first interview, I realized that I couldn't simply rely on the questions from the *Protocol on Accumulated Experiences in Math* (Appendix A) to collect data on every student's varied math experiences and conception of a math person. I felt that Stephanie's view of mathematics as a subject with a lot of rules that she needed to grasp in class needed to be brought up during her interview. Likewise, the fact that Kawhi, believed by Ms. Turner to be the most gifted math student in the honor's pre-calculus class, never raised his hand to answer a question or volunteered to go to the board deserved explanation. Or certain moments, like the time Kendrick pointed to a junior of Vietnamese background from Ms. Turner's previous period whom he did not know and said to me "He is good, right?," needed to

be included into students' formulation of a math person, and interpretation of their accumulated experiences in math classrooms. Thus, I made 11 copies of the *Protocol on Accumulated Experiences in Math* with participant's name on each one. I also left out some space between each question so that I can jot down thoughts, questions or interesting points that emerged out of a student's response. Moreover, I made little notes in the margin of certain questions on each protocol; those notes were inspired by moments and students' comments similar to the ones mentioned above that were underlined in my field notes.

May to June 2016

In the beginning of the month of May, I was visiting Oxford every day of the week and started the preliminary stage of my data analysis. The end of April marked the end of my teaching assistantship for the Spring semester at Cecil B. University. It was also nearing the end of other teaching assignments that I had as an adjunct professor at two other colleges in and near Philadelphia. My mornings and late afternoons were now free. I decided to transcribe every interview myself; transcriptions of the first rounds of interviews began the second week of may. I was scheduled to be at Oxford every day from 12:30 pm to 3:00 pm. So, every morning until about noon was dedicated for transcription. I chose *OTranscribe* as my transcription tool because I had used it for previous research projects and because it is a free google application and very easy to use. Moreover, *OTranscribe* allows you to italicize and embolden specific sections of a text. Thus, I used those two features to make notes and use parentheticals throughout each student's transcription. This was an attempt at signaling recurring patterns, uniqueness and puzzling or unclear moments in participants' responses.

I began transcribing the first round of interviews because I wanted to figure out questions to add or take away from the *Protocol About Students' Math Confidence* (Appendix B). The academic year was approaching its end and I was warned by Ms. Turner and some seniors that fewer and fewer students would be in class as we inched closer to prom night. Attendance had not changed much during the first few weeks in May. The seniors who were present most days up until then continued to attend classes most days. However, I was anxious about the second round of interviews. I was hoping to begin them the first week in June. The plan was to finish transcribing and annotating the first round of each student's interview before starting the second round. One of the goals was to prepare each participant's *Protocol About Students' Math Confidence* sheet more purposefully. Because of time pressure, the second round of interviews were going on at the same time that I was working on transcribing the first set of student interviews. I was only able to transcribe interviews with Kawhi, Felix and Nigel before interviewing them for a second time. For the other participants, I listened very closely to the audio recording of their first interviews to help me prepare.

The second round of interviews were done before memorial weekend which was also the weekend of the senior's prom. I continued visiting Oxford five days a week most weeks. Attendance for both seniors and juniors in the college pipeline had dropped drastically. Ms. Turner and I decided to administer a cumulative final exam for the 11th and 12th graders. I created a review sheet for both classes and Ms. Turner spent the bulk of June reviewing with her honor's Algebra II and pre-calculus classes. This helped improve attendance a bit as more and more seniors were getting worried about not passing the final exam and failing the class. For

some seniors, like Tyronne, failing the final would cost him credits in mathematics that he needed to complete his graduation requirements. Others like Stephanie and Tamika simply wanted to work as hard as possible to avoid a bad grade in the final exam that could negatively affect their grade point averages. Weldon was one of the few seniors who worked hard on the review packet for the final in order to be better prepared for college math. Ms. Turner said that she had to complete her grading for the year by June 10th. She said that students' grades needed to be submitted a couple of days later; however, she wanted to make sure that she didn't miss the deadline. Most of the days leading up to June 10th, seniors were either making up past quizzes or homework assignments to improve their overall grades in the class. I continued observing and documenting moments and comments from students and Ms. Turner even though there was very little real instruction taking place.

Students' last day of the 2015-2016 academic year was June 22nd and the school's staff last day was the 23rd. There were very few students in attendance during that last week. In fact, the handful of students who continued to show up were mostly juniors. There was nothing for them to do except helping Ms. Turner packing up her class. There wasn't much useful data collected during that time because most of the seniors stopped coming to school after their graduation ceremony on June 13th.

However, during that time Ms. Turner and I had many more conversations about her conception of a math person, and of the meaning of teaching and learning mathematics. She also

talked about her first years as a teacher working at Audenreid High School[2] in South Philadelphia. She compared her time there and her time at Oxford to her tenure as a math teacher at a small private catholic school. Ms. Turner underlined her relationship to parents as the most notable difference between working in private faith-based school compared to an urban comprehensive public school. She said that she felt more appreciated and even a bit feared by parents from low income communities like Oxford and south Philadelphia in the 1980's.

Most of the data collected during our conversations fell outside of the purview of this study; however, when she was prompted to name students in her honor's Algebra II and pre-calculus whom she considered "math people," her response was an illustration of what Martin (2009) called a perception of a *racial hierarchy of mathematics ability* in America created by the disproportionate number of studies focused on the failure of black students in mathematics:

> Alright, I would say, in class I would say…(she named three juniors of Vietnamese background) and I hear I'm picking my Asian students who people automatically think that it's because of that but it's, it's, I think it's more their personality. They're calm cause they, they don't always get it right away but they're patient, they would sit and they would listen, they just like calm themselves down and they're calm, they're learning. It is that personality.

Martin (2009) argued that the extant literature in mathematics education suggests that there exists a race-based hierarchy of mathematics ability that "positions…African Americans,

[2] Universal Audenried Charter High School , formerly Charles Y. Audenried High School, is a high school servicing the Grays Ferry area of Philadelphia. It was previously directly operated by the School District of Philadelphia.

Latinos, and Native Americans at the bottom," and Whites and Asians on top (p. 297). Moreover, he observed that one of the consequences of this is a pervasive belief shared among researchers, practitioners and students that black students' low performance in mathematics education can be located in the content of their personal selves, their racial and sociocultural identities.

However, all the participants interviewed for this study—they all identified as black or African Americans—characterized Ms. Turner as the best or among the best math teachers they've had in their K to 12 math education. None of them mentioned during their two interviews, even when prompted by questions like "Do you ever feel like you have to prove yourself in Ms. Turner's class?," any instances of feeling or thinking that they were receiving differential treatment based on their race. I asked Nigel this very question during his second interview because of Ms. Turner's beliefs that he was involved in illegal drugs activities; he echoed the other participants' sentiments and thought Ms. Turner was one of his favorite teachers. This was also true of my 10-month long observational notes on the honor's pre-calculus class; there were no implied or explicit moments recorded of students being treated differently because they are black. In fact, some of the seniors like Tamika, Stephanie and to a smaller extent Shalik, considered Ms. Turner a confidant or an older relative with whom they talked about personal matters they weren't comfortable discussing with their parents. Thus, the data collected during the time I spent talking with Ms. Turner the last few days of the school year, although insightful in understanding a teacher's perception of a math person and how it is shaped by mainstream beliefs surrounding the field, it remained mostly irrelevant to how this study's

participants constructed their views of mathematics education and identification with the academic domain.

Data Collection

This was an ethnographic study of black students' math experiences, confidence and identification. The study began the first day of the Philadelphia school district's academic calendar and ended June 22nd. During the months of September to December, I was in Ms. Turner's honor's pre-calculus classroom at least twice a week for the whole 45 min of class time. I began collecting and developing field notes based on classroom observations the first day of school. From January 2016 to the end of April, I visited Oxford on Mondays, Wednesdays and Fridays. I continued collecting observational data; however, after recruiting a purposeful and representative sample of 11 seniors to be part of the study, my observations were more focused on the study's key informants. I began interviewing students in March. In addition to using a *Protocol on Accumulated Experiences in Math* during students' first round of interviews, field notes were also used to help me better prepare for each interview. The same method was used for the study's second round of interviews based on a *Protocol About Students' Math Confidence.* I began transcribing interviews at the beginning of the month of May and concluded at the end of June.

As mentioned earlier, field notes were collected for every day that I visited Oxford during the 10 months of this study. Observational notes were recorded on miniature notepads and dated with the day, date, month and year (like Mon 03/28/16). At the end of each school, notes were reviewed for clarity and expanded upon. Notes were than fleshed out and recorded in paragraph

form using Word Document. Each field note was saved as a *.docx* file using the word *fieldnotes* followed by the day, date, month and year the notes were recorded as the file's name. Each file was saved in a folder named after the month when the observational notes were recorded.

At the end of study, I had about 230 single-spaced pages of transcribed interviews, more than 500 single-spaced pages of field notes, along with data on seniors' attendance and math overall grade point average for the academic year. I also had students' pre-test and post-test scores on the two college math placement exams that were administered to the seniors in September and April respectively. Field notes and interview transcripts were uploaded onto an account, *Urban Confidence of Black Students*, that I created on *Dedoose*[3]. I began uploading and organizing files on Dedoose at the end of June in order to begin the next phase of data analysis. I decided on Dedoose as the web application to assist me in analyzing the data collected for this study because I've used it in the past and have become very familiar with the software. Furthermore, the monthly subscription fee is very inexpensive and the software's features and analytical tools are arguably more user-friendly than other research-based web applications like Atlas.ti, NVivo, and QDA Miner.

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[3] Dedoose is a web application for mixed methods research developed by academics from UCLA, with support from the William T. Grant Foundation, and is the successor to EthnoNotes. Dedoose is designed, developed, and operated by SocioCultural Research Consultants (SCRC), whose majority of ownership (e.g. 2 people) consists of academics from UCLA (retrieved from http://at.blogs.wm.edu/dedoose-an-alternative-application-for-qualitative-data-analysis/)

This study subscribed to the qualitative research paradigm in that it "focused on [exploration], discovery, insight, and understanding from the perspectives of those being studied" (Merriam, 2009, p. 1). Data on students' views about mathematics and its purpose in their present and envisioned lives were collected and analyzed in relationship to their experiences with mathematics education and of being stereotyped as low-performing. Ethnographic studies, concerned with people's social and cultural practices, attempt to examine and unpack preconceived assumptions about people's *lifeworlds*.

Fieldnotes and interviews, along with other date sources were used to provide in depth, analytical and rich description of students' perception of teaching and learning mathematics, and their sense of belongingness to the domain. Van Maanen (1982) explained that, "The result of ethnographic inquiry is cultural description…a description…that emerge[s] from lengthy period of intimate study and residence in given social setting" (pp. 103-104).

Data Analysis

I began the preliminary stage of data analysis very early on in this study. As previously mentioned, my daily field notes went through a two-level review and developmental process. Observational notes were first reviewed and expanded upon minutes after Oxford's bell rang the end of the school day. Then, later on, usually in the evening, field notes were transferred from my miniature notepad to a *Word docx* file. The transfer process typically entailed further review and more fleshing out of field notes, especially of moments and comments from students and teachers recorded that piqued my interests or were simply confusing. I used word docx's "New Comment" and "Track Changes" features to underline chunks of text that I thought needed to be

investigated or paid closer attention to during my next visit. This was my attempt, early on in the study, to identify recurring patterns in the data being collected. Moreover, these two features made it possible for me to connect moments in a day's field note that could be potentially related to this study's conceptual framework and/or research questions. For instance, from field notes recorded on February 10th, I used "New Comment" to highlight this section of the data collected that day:

> Other students put the work that Ms. Turner gave them aside to finish or catch up on old homework that they hadn't done yet. Many students had old, completely blank or partially completed worksheets in front of them. Some were simply copying from classmates; others were attempting to solve some of the problems on their own…from my observations, it is not uncommon to have the majority of the students (11th or 12th graders) with incomplete homework (Fieldnotes, Wed 02/10/16).

Those were typically juniors and seniors who checked their grades several times a day on their cell phones and were constantly asking how they can make up or retake an assignment. Thus, I note in the margin of the passage above that this was an illustration of the "Attitude Achievement Paradox" theory where students' perception of the importance of doing well academically doesn't match the amount of effort they put into their school work (Noguera, 2008; see also Mickelson, 1990). This moment resurfaced during the fleshing out of other days' field notes and the transcribing of participants' interviews.

Later on in the study, especially after transcribing all 22 recorded interviews, moments like the one mentioned above helped to shape and sometimes challenge my understanding of

high achieving students' explanations like Tamika, Shalik, and Stephanie for why they no longer or never identified as math people. Especially in the case of Stephanie who was one of the hardest working seniors in the honor's pre-calculus class but didn't feel the need to do any math at home. During her second interview, she said that her motivation to do well academically stemmed from her perceived social responsibility as a black student to "prove them wrong;" however, when it comes to math, she interpreted willing or choosing to put more effort as personal and unrelated to her social responsibility. Using "Track Changes," I made a note in her transcript that Stephanie's complex relationship with mathematics is not only consistent with one of Mickelson's (1990) key findings that "race and class…influence school outcomes" (p. 44), but that it complicated the notion of attitude-achievement paradox and underscored the salience of race in investigating black students' identification with mathematics.

The notes made in the margins and within the body of field notes collected during the academic year and throughout students' interview transcripts were used to begin thinking about and developing this study's coding scheme. Once all the data collected was uploaded onto my account on Dedoose, I started rereading and reviewing each document. This time the goal was to identify and confirm recurring patterns or themes against my notes in the margin and throughout the document. It was also to underline singular or unusual ones.

Analytical memos—It is important to also mention the role that *memoing* played in the conception and design of this study's code structure. Because of the amount of data that I anticipated having to collect during a 10-month long ethnographic study, I decided to implement early on a way to check periodically on the data being collected. The use of memos was borne

out of fear. With all my responsibilities at Oxford coupled with keeping up with my adjunct professor's teaching load every semester, I felt the need to keep track of "ideas [that] may be otherwise lost" (Birks, Chapman, & Francis, 2008, p. 69; see also Glaser, 1978). With notes and thoughts sprinkled all over the data being collected, memos were my attempt at organizing and managing those notes. Moreover, as argued by Birks, Chapman and Francis (2008), "regardless of how inconsequential…thoughts, feelings, and impressions may initially seem,…memos ensure the preservation of…ideas that may later prove significant" (p. 69; see also Polit & Beck, 2006).

Usually referred to as analytical memos, they were, for me, short reflective essays that synthesized and were inspired by notes made in the margins of my daily field notes. Memos were often written at the end of a month's worth of observational notes. Although memos were by and large extensions and attempts at making sense of my annotations of the data being collected, they varied significantly in their focus and sometimes purpose. For instance, at the beginning of this study, my first memos were mostly a mixture of complaints for not collecting enough meaningful data and anxiety because I was struggling to make sense of my participant-observer role. Other memos written later on in the study focused more on weaving together poignant moments and comments recorded in my field notes at different points in the study that were seemingly unrelated. Toward the end of the study, I used memos as a way to figure out potential relationships between different patterns and create room for the emergence of new ones. However, overall the 9 memos written during this study helped cementing the process of

identifying themes and recurring patterns. They served as the foundation for the formulation of the first set of "codes" that emerged out the data collected for this study.

Coding Structure—This process generated a total of 65 codes initially. Dedoose allows you to create "Root" or parent codes and "Child" codes. A careful review and analysis of the documents uploaded onto my Dedoose account in conjunction with the analytical memos developed during the course of this study produced eight root codes. Each parent code was broken up into child codes. There were nearly 500 excerpts selected and coded from the interview transcripts and field notes uploaded.

The "Analyze" feature of Dedoose was used to identify the codes that were applied with greater frequency. This feature also allowed me to find out codes that were applied concurrently for the same excerpts. For instance, "Math Experiences" and its child codes were applied 85 times; some of those codes like "Positive Experiences," "What it means to learn math," and "Attitude Achievement Paradox" were applied to a significant number of excerpts simultaneously. Through this process the root codes "Math Experiences," "A Math Person," "Racial Identity Construction," and "Math Confidence" emerged as this study's seeming main points of focus. Then, I downloaded and saved as word *docx files* all the excerpts that were coded with the aforementioned parent codes and their child codes. For instance, excerpts coded by "A Math person" along with passages labeled codes like "A Math person if a thinker/logical person," "A person who know the basics," and "Definition of a math person" were downloaded. These new files were saved in four different folders. Each folder was named after a parent code.

The excerpts, passages extracted from field notes and students' interview transcripts, were studied, one folder at a time. Each set of excerpts were reviewed and analyzed with the objective of piecing together a narrative specific to to each parent code. In practice, this meant identifying the child codes that were applied more frequently and underline the themes or ideas common to the majority of those coded passages. I was also careful to include patterns that either opposed or suggested something different than the dominant narrative. For instance, the files saved under "Math Experiences" suggested that 9 out of the 11 participants in this study felt positively about their K to 12 experiences in mathematics classrooms. This was true for seniors who performed well and who struggled in honor's pre-calculus. However, Stephanie and Tamika, described their overall experience with math education as a struggle. This was odd and worth noting because those two seniors experienced considerable overall success in mathematics and were among the high achievers in the honor's pre-calculus class. Those two exceptional cases that emerged out of the data coded "Math Experiences" forced me to rethink and revaluate mainstream beliefs about academic achievement and its assumed impact on academic identification; it also called for greater attention to students' perception of mathematics education.

This culminated into an outline of the main themes that emerged out of the data collected during the course of this study. This process also allowed for each theme to be unpacked and developed into inter-related key findings and in relationship to other themes.

Participants

As stated earlier, a purposeful and representative sample of eleven seniors were selected

from Oxford's honor's pre-calculus class. Those students served as this study's key informants. Participants were all part of the E&Y and Cecil B. University's college pipeline program. They were selected for this study based on their academic history, average grade and attendance in honor's pre-calculus in January 2016, and Ms. Turner's recommendations. Students were labeled "High-Ability & High-Confidence," "High-Ability & Low-Confidence," "Low-Ability & High-Confidence," and "Low-Ability & Low-Confidence" based on their grades, scores on the Likert scale *Survey on Mathematics Confidence*, and my observational notes. Every participant was given a pseudonym and was only referred to as such in students' interview transcripts and the study's field notes.

This study began the first school day of the 2015-16 academic calendar and continued until the end of the school year. Field notes were collected during every visit for ten months. This study's unit of analysis was Ms. Turner's honor's pre-calculus class. All the participants interviewed for this study were enrolled in the course for the whole academic year. They elected to take honor's pre-calculus their senior year; the class was not a requirement for graduation. Ms. Turner and her two student teachers, Mr. Bond and Mr. London, were also interviewed to provide more insights and background information about their perception of mathematics education and of a classroom of mostly high-achieving black students who chose to enroll in Oxford's highest level math class in spite of the pervasive belief of their mathematical inferiority compared to white and Asian students.

Table 3.2 Study's Time Line

Time	Research Activities	Participants	Purpose
Sept to Dec 2015	• Administered Pre-test • Informal Classroom Observations (2-3 days a week) • Informal observations of individual and small groups of students working on mathematical tasks • Working with individual and small group of students • Weekly Conference with Math Teachers • Taught or co-taught whole class occasionally • Informal Interviews of students • Informal Interviews of Ms. Turner and Mr. Bond • Write first round of Analytic Memos	• 12th grade students in Honor's Algebra Class • Began the process of identifying key informants • Ms. Turner—Lead teacher • Mr. Bond—student teacher from Cecil B. University	• Becoming familiar students and their relationship to mathematics • Documenting seniors' verbal and behavioral responses to specific tasks • Establishing a better rapport with individual students • Identifying high-ability and low-ability students using test scores, performance, and observational notes • Cultivating a more organic relationship with Ms. Turner and Mr. Bond. • Identifying high-confidence and low-confidence students.

Table 3.2, continued

Time	Research Activities	Participants	Purpose
Jan 2016 to April 2016	• Administering the *Mathematics Confidence Survey* using a Likert scale • Classifying students using the constructs math ability and math confidence • Identifying and distributing consent/assent forms to the study's key informants • 1st Round of formal semi-structured interviews with key informants—focus on students' accumulated experiences in math education and backgrounds • Continuing field observations • Weekly Conference with Math Teachers • Informal interviews • Administer Post-tests • Begin transcribing first round of interviews • Begin preliminary coding of field notes and transcripts. • Continue Analytic memos	• 12th grade students in Honor's Algebra Class • 11 key informants • Ms. Turner—Lead teacher • New student teacher from Cecil B. University	• Understanding students' overall experience with mathematics • Trying to make sense of students' view of a math person • Identifying themes/patterns through a comparative analysis of multiple data sources

Table 3.2, continued

Time	Research Activities	Participants	Purpose
May 2016 To Sept 2016	• 2nd Round of formal semi-structured interviews with key informants—focus on students' mathematics confidence and sense of belongingness • Continuing informal observations of class 3 to 4 times a week • Beginning of triangulation process—Comparative Analysis of students' notebooks, completed worksheets homework, quizzes, unit tests, and post-test results • Analysis of students' gain/losses bet Pre-tests and Post-test scores. • Secondary level of coding—confirming and disconfirming themes/patterns through an ongoing triangulation of multiple data sources. • Member checking • Complete first draft of Chapter IV—Results section • Revise Chap III—Methodology section	• 12th grade students in Honor's Algebra Class • 8 key informants • New student teacher from Cecil B. University	

Table 3.2, continued

Time	Research Activities	Participants	Purpose
Oct 2016 to Dec 2016	• Tertiary rounds of comparative analysis • Finalizing coding • First draft of dissertation • Revisions • Tentative Dissertation defense.		• Confirming themes about students' mathematics confidence • Developing theories relating to students' mathematics confidence, its relationship to their accumulated mathematics experiences and its impact on their view of the purpose of mathematics

Limitations

As stated earlier, this study was part of an ongoing, larger college pipeline program and research project sponsored by the firm E&Y and carried out by the Cecil B. Moore University. Students were selected based on teacher recommendations, grade point average, attendance and good behavior. Most of the seniors who participated in this study were in the program for more than a year prior to the beginning of this project. All of the students in the college pipeline

program received additional support from E&Y staff like mentoring, tutoring, assistance with college essays, academic advising, etc…Many of the seniors were gifted new Lenovo personal computers at the end of the academic year for their participation in the E&Y and Cecil B. Moore University's college pipeline program.

Students selected for this study received a richer, and more rigorous academic experience compared to other juniors and seniors at Oxford high-school. For one, all of the students in the college pipeline are enrolled in either honor's algebra classes, or honor's English classes. The majority of the students are enrolled in both. Those courses' curricula are designed by Cecil B. Moore's faculties and doctoral students. The courses were taught by a team of Oxford's veteran teachers and Cecil B. Moore's doctoral students. Unlike the other students at Oxford, the students selected for this program had two or more teachers in their math and English classes most days of an academic week.

One possible limitation for this study is students' inflated sense of academic confidence. Being selected to be part of a well-resourced and relatively rigorous academic program can create a sense of academic superiority in some of the students. This can potentially skew students' feelings about mathematics education and their belonging to a mathematics community of learners. For instance, Andre, during his first interview said that he believed that every senior in Ms. Turner's honor's pre-calculus class was a "math person." Because the course was an elective for most of the students in the class, a senior electing to take an advanced math class unnecessary for graduation was, in Andre's mind, proof that they identified as a math person. It

was also routine for Ms. Turner or her student teachers to characterize the honor's students from the college pipeline as "good kids" compared to the other students in the non-honor's math classes.

On the other hand, the increase in academic rigor and attention that the students selected for this program received in their math and English courses could have had the reverse effect on their overall academic confidence. Being part of the college pipeline program could have discouraged some struggling students like Kendrick and Tyronne further and prevented them from developing the sense of belongingness or academic confidence needed to conceive of college as a possibility. In fact, as detailed in this study's results section, both students devised alternative plans in order to avoid taking college math courses. Tyronne decided against applying to college because he did not believe that he could pass the math college place exam; he chose the navy over going college. Similarly, Kendrick chose to become a fire-fighter and was contemplating ways to avoid taking anymore math classes especially if it wasn't a requirement for the civil service examination. One potential reason for this is that students were recruited into the program as juniors and not freshmen; thus, by the time students like Kendrick and Tyronne joined the college pipeline program, they had already math identities and relationships to mathematics education that conflicted with the expectations and mission of E&Y. For some students, being in enrolled in honor's pre-calculus has solidified their conviction about their math ability; it has substantiated their view of the role mathematics will likely play in their college and professional lives.

Another potential limitation for this ethnographic study of students' math confidence is my experience as a former mathematics teacher in urban public schools. I have worked as a mathematics specialist in a prominent charter elementary school in Harlem, NYC, and as an Algebra II/trigonometry and geometry teacher in a south Bronx public high school. My experience teaching mathematics has been in classrooms of mostly kids from communities that have been trapped in poverty-stricken urban districts for many generations (Noguera, 2003; Sharkey, 2013; Wade, 1995; Wilson, 1989; Wilson, 2008/2009). Wilson (2009) observed that decades of racially and non-racially biased policies have contributed to the concentration of poverty in inner cities largely populated by African American families (p. 570). And other studies have documented the crippling impact of poverty on students' academic performance (e.g. Coleman et al., 1966; Noguera, 2009; Sharkey, 2013). So, teaching mathematics in schools similar to Oxford have always meant more to me than transmission of a set of procedures or concepts. I viewed teaching students how to graph logarithmic functions (like $y = \log_a x$) as "requirements that [were] becoming prerequisites both for citizenship and for competing in the emerging global economy" (Silva, Moses, Rivers, & Johnson, 1990, p. 378). And because the classroom tends to separate and give primacy to "scientific concepts" over kids' daily activities, particularly in mathematics, students often feel forced to set "their reality aside to engage in" academic learning (McNair, 2000, p. 559). So, I contend that a critical aspect of my role as a mathematics teacher was to create a "low-anxiety classroom environment" (Young, 1991) in

order to encourage or make it easier for more students to engage with abstract mathematical concepts.

One of the ways that I attempted to make learning geometric and algebraic axioms less anxiety inducing and more engaging for students from the south Bronx was through humor. I frequently cracked jokes, or teased students and invited them them to do the same at opportune moments during class. For example, during independent work time, I would tease student athletes: 'if you get this done in the next fifteen minutes, I would let you win next time we play ball.' I actually did play basketball a few times with some of the students from my geometry class in the school's gymnasium. I tried forming similar relationships with some student athletes from Oxford. Felix and I had several exchanges centered around basketball and the fact he was no match for me. We made plans to play one-on-one at a nearby gymnasium at least once a week but it never happened.

Another way was through cultivating more organic relationships with students, and making genuine efforts to learn more about their interests. As a math specialist in Harlem, New York, I found out that one of the struggling fourth graders with whom I work everyday in small groups was interested and showed talents for drawing. So, during some lessons I would allow her to take drawing breaks. Or, I sometimes asked her to draw what she thought a particular mathematical task was about. At Oxford, I had similar relationships with many of the participants. For instance, after finding out that Stephanie and Shalik were performance artists, we spoke often about acting or theatre and that majoring in theatre as a college undergraduate

was not a waste of time. I told them about my experience as a theatre major and the role that acting played and continued to play in my life.

One of the reasons that I ended my career as a mathematics teacher was the fact that I viewed myself as part of an institutional failure to create opportunities for racial minority students living in low income communities to engage with mathematics meaningfully. Thus, it is reasonable to argue that my interactions with students during the course of this study and my observations of their responses and identification with mathematics were tainted by my perceived failure as a former high school and elementary mathematics teacher. It is also plausible to assume that the relationships that I formed with this study's participants were motivated by my perceived social responsibility to help more and more black students succeed in mathematics and fulfill their "requirements…for citizenship and for competing in the emerging global economy."

So, I certainly played a significant role in how the seniors who participated in this study experienced pre-calculus. I was responsible to create the weekly lesson plans and in class assessments used in the honor's algebra II and pre-calculus courses. Moreover, several times a week, I was in the classroom working with individual students and small groups on mathematical tasks. I also supervised and observed Ms. Turner and her student teachers to ensure that lessons were implemented in ways consistent with Cecil B. Moore University's math education philosophy and pedagogy. This was coupled with the numerous side conversations, inside jokes, taunting that took place before, after and during class between myself and many of the participants. Thus, the combination of academic and non-academic related interactions that I had

with the seniors from Ms. Turner's honor's pre-calculus class over a period of ten months have likely helped to affirm or challenge students' views and identification with mathematics.

Lastly, being a black man who, during the course of this study, worked at several colleges in and around Philadelphia as an adjunct college math professor, my decision to focus on students' sense of belongingness to mathematics as an academic domain "was as much about [high achieving black students'] narration of their experiences as it was my own" (Ibrahim, 1999, p. 355). On several occasions, whether in parking lots, learning labs, libraries or classrooms on college campuses in the city of Philadelphia or in its neighboring suburban districts, I had to provide evidence of my membership to the institution's teaching faculty. Those experiences ranged from having to convince other professors that I was in the learning lab waiting for students and not seeking tutoring, or showing a campus security officer my photo id even after displaying my faculty parking permit, to pretending not to notice the disbelief across people's faces when I replied that I teach college math. My own frustrations with having to always prove or explain that I'm a member of the community of math learners and doers certainly contributed to some of the motivations for this study of high achieving black students' math confidence.

Those frustrations could have also influenced my data collection process and analysis. Particularly, during interviews, my own experiences being part of an academic domain, a field within which I'm stereotyped as inferior, probably skewed my questions and interests toward the intersectionality of students' racial and academic identities. Likely, my 10 months in the classroom as a participant-observer were surely dominated by my need to understand how high

achieving black students make sense of being stereotyped as low-performing in a discipline that they've accumulated success in.

Larger Research Issues

This study subscribed to the qualitative paradigm and made use of ethnographic methods to collect and analyze data. Qualitative studies being descriptive in nature requires very detailed (thick) narrative description of the phenomenon and patterns studied and found. Researchers are required to provide the reader with an "extensive and careful description of the time, place, context, and culture" of the lived experience of the study's participants (Merten, 2015, p. 271). The purpose of the thick description is to enable readers to "understand the complexity of the research setting" and to "make judgments about the applicability of the research findings to their own situations" (p. 272). Moreover, because this study, consistent with the qualitative paradigm, was conducted in students' natural settings—the classroom is a natural setting because it is where students are accustomed to experiencing teaching and learning—changes and unpredictable occurrences "should be tracked and [acknowledged]" (p. 272). As stated earlier, my vested interests in high-achieving black students' identification with mathematics could have limited my ability to identify and consider occurrences and patterns that fell outside the purview of this study's research questions. This is the reason why the researcher is required to provide ample and 'rich' evidence throughout the study that the data reported and its analysis aren't made up or imagined.

Finally, because qualitative research theorizes about people's lived experiences, it is critical that researchers are cognizant of the potential impact their findings and interpretations can have on a community. This is particularly true in the case of this study where all of the participants are from racial and social backgrounds historically stereotyped as academically inferior.

CHAPTER 4

RESULTS

This study examines black students' perception and identification with mathematics and its impact on their envisioned academic and professional lives. Eleven seniors from an honor's pre-calculus class were selected for this project. Students were selected based on their academic history, performance in honor's pre-calculus and math confidence level. This chapter examines key patterns that emerged out of an analysis of students' accumulated experiences in mathematics classrooms and how those experiences have informed and helped to shape their identification with the academic domain, and their conception of a math person. Findings are organized around three main sections: "Impact of Accumulated Math Experiences," "What does it mean to be a *Math Person*," and "Math Confidence."

In the first section, most of the participants described their overall mathematics experience positively. The majority of the students believed to be very good math students throughout elementary and middle school. However, there was considerable variability in how students interpreted the meaning and significance of their history of success in math. There were also critical differences in how students connected their mostly positive experiences learning and doing mathematics to their interest and performance levels in honor's pre-calculus class.

In the second section, participants defined a *math person* as an exceptional thinker, likely born with natural aptitudes for numbers. Most students believed to have been math people in elementary or middle-school. However, only seven out of the eleven participants still identified as math people during the time of this study. Another critical pattern discussed in this section is

the fact that most of the students failed to identify anyone else in the honor's pre-calculus class as a math person. In fact, a few students did not even conceive of being in an honor's class at Oxford as indication or evidence of their college readiness.

The third section focuses on students' mathematics confidence. As mentioned in chapter two and three, the construct math confidence, discerned from self-efficacy, is defined in this study as a sense of belongingness to the community of math learners and doers (e.g. Bowler, William & Brown, 2000; Burton, 2004; Darragh, 2013; Esmonde, 2009; Hardy, 2007; Lerman, 2009; Valeras, Martin, & Kane, 2012). None of the participants thought of themselves as members of the math community. This was true of students who struggled in the honor's pre-calculus class and of the ones who were successful. In fact, students belonging to the latter group drew a distinction between identifying as math people and membership to the academic domain; this was their way of explaining and justifying not being interested or feeling compelled to commit to math oriented career pathways.

The participants underscored the significance that race played in their academic lives. They expressed an acute level of awareness of the historical meaning of identifying as black Americans and an unyielding sense of responsibility to always have to be better than average. A number of the participants attributed their academic success to being motivated and needing to change the disparaging mainstream narratives associated with being African American. However, pertaining to mathematics many of the participants characterized membership or commitment to the academic domain as a personal choice. None of the participants believed there was a relationship between being stereotyped as low ability in the field of math education

(e.g. Frankenstein, 1995; Cobb et al., 2008; Martin 2000; Boaler & Greeno, 2000) and their dissociation with the community of math learners and doers.

This study's findings are consistent with educational researchers' call to focus more studies on students' perception of mathematics education and math identity construction (e.g. Esmonde, 2014; Frankenstein, 1983, 1989; Freitas, 2008; Gower, 2015; Greer & Mukhopadhyay, 2003; Gutierrez, 1996, 2008; Martin, 2000, 2003, 2006, 2007, 2012; Martin & Davis, 2008; Martin, Gholson, & Leonard, 2010; McCoy, 2008; McGee & Martin, 2011; Reyes & Stanic, 1988; Tate, 1994; Tate & Rousseau, 2003). Additionally, this study challenges mainstream beliefs that competence in an academic domain breeds confidence or vice-versa, especially as it relates to black students who have been overrepresented in the field as low performing. I posit that confidence, operationalized as membership, allowed me to gain a deeper and more layered understanding of black students' view of mathematics education and sense of belonging to the academic domain.

School Context

This study made use of ethnographic methods in order to examine the math confidence of black students in an honor's pre-calculus class. The study was conducted at Oxford High School, a comprehensive urban public school in the northeast section of Philadelphia. Oxford is part of the city's public school district and received an overall performance grade of 1 out 10 at the end of the 2015-2016 academic year (*Great Schools PA,* 2016). Only 11% of Oxford's students scored proficient or better in their algebra Pennsylvania Keystone Exams (*U.S. News and World Report*, 2016). Moreover, Oxford, along with Abraham Lincoln High School and Thomas A.

Edison High School, were on the district's list of the "12 Philly Schools on Persistently Dangerous Lists" during the 2011-2012 academic year (Williams, 2012; Limm, 2013). And even though violence has been declining in Philadelphia's public schools for the last few years (Limm, 2013), the number of "serious incidents" involving "weapons" and "assault" at Oxford these last couple of years were still stubbornly high compared to the district's average (*The School District of Philadelphia*, 2015).

However, I did not witness or experience any instance of violence during this study. This was true for both the honor's algebra II and honor's pre-calculus classes. During the ten months that I visited Oxford several times a week, most mentions of violence recorded in my notes came from Ms. Turner who would randomly bring up students whom she believed were involved in gang or drug related activities. The only other references of violence came from another Cecil B. "Moore" University's investigator who was responsible for the honor's English classes. By the time of this study, he had been a student investigator at Oxford for two consecutive years. He warned me a few times both before and during the course of this study about working at Oxford. I documented one of those instances below:

> On my way back to my car parked on Broad Street, I spotted the other student investigator smoking a cigarette in front of […] building. It was bitterly cold that day. We greeted each other. He proceeded to tell me about a riot that happened the day before at Oxford where 6 students were arrested. This was unprompted—it's important to note that he, in our first meetings (over the summer months preceding the beginning of the 2015-16 school year), thought it critical to inform me of how chaotic/crazy Oxford was and

> how I should brace myself for the worse. This is worth noting because my experiences observing Ms. Turner's 9th and 10th periods math classes are the furthest things away from chaotic and crazy (Field Notes, Wed 01/20/2016).

The important fact here is that ten months of observational notes and hundreds of pages of interview transcripts showed no evidence of violence in Ms. Turner's classroom or among the juniors and seniors enrolled in those math classes. Students were generally cooperative and receptive of the classroom's rules of conduct and academic demands. In fact, both student teachers—Mr. Bond and Mr. London—who assisted Ms. Turner during the Fall 2015 and Spring 2106 semesters respectively, were pleasantly surprised by how well students responded to them (Mr. Bond, Personal Interview, 12/05/2015; Mr. London, Personal Interview, 05/04/2016). So, it is conceivable, given Oxford's documented history of violence and the anecdotal accounts recorded in my field notes, that the students observed for this study were learning and doing mathematics in a classroom atmosphere unlike the larger school culture. In other words, a classroom composed of mostly Oxford students with good academic or behavioral history combined with the additional support and resources provided to every junior and senior recruited into the college pipeline program created a subculture somewhat independent of the broader social and cultural realities of being a student at Oxford.

This was also true for the honor's students' academic achievements relative to the majority of Oxford's student population. While the school only graduated 60% of their seniors' class at the end of the 2015-16 academic year, every student in Ms. Turner's honor's pre-calculus class had fulfilled their credit requirements for graduation long before the deadline. In

fact, most of seniors in the college pipeline were already enrolled at a college or were finalizing their decisions on which college to attend months before the end of this study. Moreover, Weldon, Oxford's 2016 valedictorian, Nigel, the prom king, and Anita, one of the finalists of the district's annual science fair, were all seniors in the classroom observed for this study. The winner of the 2016 science fair was a junior in Ms. Turner's honor's Algebra II class whose achievements were captured in the *Liberty City Press* (Treatman, 2016). This is striking given the fact that in 2015 only 4% of the 146 Oxford juniors tested in the state's Biology I exams scored proficient or better (*Great Schools PA,* 2016).

While many of the more academically successful Oxford students were in Ms. Turner's honor's math classes, there were among them a significant number of juniors and seniors who struggled the whole year keeping pace with the academic rigor of those classes or developing a positive identification with mathematics. For instance, Tyronne's experiences in honor's pre-calculus informed his decision not to apply to college. By the end of the academic year, he was convinced that he would not pass the college placement exam that students with low math SAT or state standardized test scores are required to take in order to complete their college admission. Some juniors and seniors simply stopped coming to class or transferred out of the honor's math classes for other courses like statistics. One of the reasons for an honor's pre-calculus class with mixed ability students like Weldon and Tyronne is the fact that students were recruited into the program in their junior year; and recruitment was mostly based on teacher's and administrator's recommendations and less on students' academic history. According to Ms. Turner, some students were placed in the honor's college pipeline program based on previous academic

successes and others were selected because administrators believed they would benefit from being surrounded by peers who were motivated and hard working.

Classroom Context

Understanding the context in which the participants of this study were learning and doing mathematics meant paying close attention and documenting the classroom culture. Ms. Turner's classroom was no different than many other math classrooms that I've been in as a teacher or a student. Most of the time, students sat in desks arranged in rows facing an interactive white board (Smartboard) mounted at the center of a wall in the front of the classroom. Most lessons followed a teacher-centered approach where Ms. Turner or a student teacher controls and dictates most aspects of the learning. Cuban (1983) explained in his survey of a century of the evolution of teaching practices in the U.S. that teacher-dominated classrooms represent "a seemingly stubborn continuity…despite intense reform efforts to move classroom…towards more student-centered [practices]" (p. 160).

In some respects, Ms. Turner's honor's math classes represented illustrations of the stubbornness of teacher-centered pedagogies. Some of the lessons or mathematical tasks designed for the honor's pre-calculus class were based on Star's (2005) concept of "deep procedural knowledge" which he described as "knowledge of procedures associated with comprehension, flexibility, and critical judgment…distinct from (but possibly related to) knowledge of concepts" (p. 408). This was a part of the pedagogical orientation of the college pipeline program which aimed at creating more opportunities for exploratory learning, fostering more conceptual understanding and critical thinking. In honor's algebra II and pre-calculus, this

meant an attempt to shift from instructional practices focused on getting the right answer or using the right procedure to deepening students' mathematical understanding, flexible problem-solving ability and analytical competencies. The data collected from my observation of Ms. Turner's honor's math classes is consistent with Cuban's (1983) main finding; teacher-centered instruction remained the dominant teaching practice in spite of changes in "curriculum theories" (p. 160). Part of this was the fact that Ms. Turner had been teaching mathematics for over thirty years and experienced a mostly teacher-centered mathematics education as a student. She conceded during her interview at the end of the academic year that she wished that math education would go back to "rote learning"

> when I was younger we did a lot of rote learning, ok. We had to memorize our math facts, memorize our square roots, memorize our perfect squares. I think that a lot of that they took away because they don't want students to be learning in a rote manner. I think they need to bring that back because I think that there's a benefit to rote learning. I don't think it should be utilized all the time but I think there're certain things should be, certain basic things should be learned in that manner (Ms. Turner, Personal Interview, 06/14/2016).

Ms. Turner, during the days that I was there, made genuine attempts to be faithful to the lessons and mathematical activities aimed at developing students' deep procedural knowledge. Nonetheless, implementing those lessons faithfully, and creating a learning environment based on student-led discussions seemed outside of her comfort, and at times in conflict with her

professional and experiential beliefs of teaching mathematics in an under-resourced, urban high school.

Ms. Turner also seemed unwilling to give serious consideration to pedagogies and teaching methods different than the ones that she spent more than thirty years cultivating. Early into this study, the lack of effort and time she devoted into preparing for the honor's math classes captured my attention and quickly became one of this project's focal points. This is documented in my field notes extensively. In fact, most of my field notes begin with a version of the following:

> I got to class and saw Ms. Turner and Mr. London sitting almost facing each other. I asked what was planned for today. Ms. Turner confessed—she didn't seem at all concerned or worried about this admission—that she didn't look at the lessons yet (the juniors were due in less than 10 min). Mr. London was grading papers and Ms. Turner's desktop was littered with brown paper bags, a lunch box and other plastic bags. It appeared that she just had lunch. (Field notes, Mon 02/01/2016).

It was fairly routine to observe Ms. Turner scheming through a lesson minutes and sometimes seconds before students began trickling into the classroom. As mentioned in chapter three, every lesson for the honor's Algebra II and pre-calculus class were created by a team of student investigators and college pipeline's project investigators. Lessons were sent to Ms. Turner weekly via electronic mail. Ms. Turner and I never discussed her reluctance to read over the lessons and plan their implementations during prep periods. I never felt comfortable bringing it up. The closest we came to a conversation about how she prepares for class was during her

interview. Even then, I was careful to frame my question more as an inquiry into her philosophy of education and her beliefs on teaching mathematics:

> I'll do my lessons in the morning because those are the ones that I prepared for myself. I'll always look to see because I know the topics we're supposed to be teaching. They give us the book and you're free to teach anything in the book. There's about 7 key things that I always like try to get them to understand. I figure there are 7 or 8 things that I really hope they understand, just to get a general feeling (Ms. Turner, Personal Interview, 06/14/2016).

Ms. Turner conceded that she relied on her teaching experiences and beliefs of the "key things" students need to learn in a math class to plan her lessons and inform her methods. She also alluded to how she viewed teaching and learning algebra as "7 or 8 things" that students "just [need] to get a general feeling" about. This was echoed by Mr. Bond, the student teacher of the fall 2015 semester. He spent nearly every school day in Ms. Turner's classroom for fifteen weeks. He was in the honor's math classes and in the two other math classes that Ms. Turner taught in the fall. I interviewed Mr. Bond at the end of his student teaching assignment and he offered the following as a possible explanation for why Ms. Turner did not feel the need to prepare:

> From what I've observed she's [of] the attitude that she's done all this. She hasn't ever explicitly said this but from what I've observed, she doesn't need to prep. She thinks that if 'we're talking about this subject, oh, ok, I know how to explain this subject.' She has her talking points if you wanna call them that and she has them memorized. She's been

> teaching for 30-40 years. Again, when you're teaching procedures, it's really easy. She has all the procedures memorized. And so that's essentially what she's doing. She'll sorta follow the key points of the lesson, but all she's saying is oh this is what it's talking about, oh I know the procedures for that (Mr. Bond, Personal Interview, 12/05/2015).

The point here is not to depict Ms. Turner as the sole reason that the honor's juniors and seniors experienced a mostly teacher-centered mathematics education. There were many moments recorded in my field notes where juniors and seniors were impatient and resistant to exploring the concept or meaning behind a particular mathematical rule. Students complained that Mr. Bond, who described a math person as "someone who understands logic," was at times 'making things difficult for no reason.' Nor is it to characterize exploratory learning as more meaningful and valuable than the teacher-centered classroom. The important finding here is that the mathematics education that the participants were experiencing in Ms. Turner's honor's pre-calculus class was not atypical of the traditional and still predominant conception of a mathematics classroom as dominated and controlled by "teacher-talk" (Cuban 1983, pp. 160-161). In this "transmission model," this study's participants' role in the classroom was primarily that of a "knowledge consumer" at the mercy of the teacher, the sole "knowledge producer" (McNair, 2000, p. 551).

Nonetheless, interview data and observational notes collected for this study showed that most of the students in the honor's pre-calculus class felt positively about Ms. Turner's teaching methods. During their interviews, Shalik and Nigel described Ms. Turner as one of the "best math teacher" they have had in their K to 12 education. In fact, Shalik believed Ms. Turner to be

a “math person” because “when [they] have a question for her that she didn't even see yet. She looks at it and she has a vision of what she has to do to get the right answer and she does it” (Shalik, Personal Interview, 02/05/2016). Because of this, Nigel, along with other students, thought it insulting and unfair for Mr. Bond or Mr. London to teach whole lessons for many consecutive days. In Nigel’s view, student teachers should not be “experimenting” on him (Field notes, Tue 11/10/15). He did not make sense to him that college students were ‘learning how to teach’ at his expense while a veteran educator was standing nearby. Other students, in spite of the fact that they were mostly receptive to Mr. Bond and Mr. London, were less tolerant of the student teachers’ occasional faux pas or lack of clarity in their presentation of a mathematical concept or review of a task. Many of the students observed during this study exhibited and expressed genuine respect and appreciation for Ms. Turner as a mathematics teacher.

Most of the students in the honor’s pre-calculus class were responsive to and, in some cases, appreciative of Ms. Turner. By the time of this study, she had been teaching mathematics for over thirty years. Most of her career as a teacher has been in under resourced, urban public schools like Oxford. All of the participants have had Ms. Turner as a math teacher for most of their secondary education. She had been at Oxford as a mathematics teacher for over ten years and had taught algebra, algebra II, honor’s algebra II, pre-calculus and honor’s pre-calculus. For some seniors, she had been their math teacher since freshman year. She knew many of the seniors in the honor’s pre-calculus very well; and for some, she seemed to serve the role of a surrogate parent or that of an older relative.

This was evidenced in how students reacted to some of Ms. Turner's quirks. She was very comfortable sharing aspects of her personal life. In class, she routinely made quasi humorous and self-deprecating remarks about her age or her thirty-year career teaching. Students' response were usually variations of 'my mom was a baby' or 'my dad wasn't born yet.' Those remarks were often punctuated by Ms. Turner's ambiguous feelings about retirement. Although she never revealed her age—she only hinted at it or presented it as a math problem, 'I graduated college in 1980'—it was evident that she was very conscious of it. Similarly, Ms. Turner was quick to offer students insights about how difficult it is to be a parent and that they should try to be more understanding of the efforts that the adults in their lives were making every day to ensure them a better future. She often substantiated those advices with her experiences as a teenager or the troubles that her teenage niece was getting into. It is worth noting that Ms. Turner does not have children. She confessed during one of our meetings that "her ex-husband…suffered from drug addiction…[and] that she wanted kids but her ex-husband didn't want them" (Field Notes, Mon 02/01/2016). However, she rarely missed on an opportunity to provide life lessons mostly aimed at helping teenage boys and girls make sense of the adult world awaiting them. Students' reactions seemed to be mostly a combination of gratitude and attempts at figuring out how Ms. Turner compares to their actual parents or guardians.

Ms. Turner knew many of the seniors in the honor's pre-calculus very well; and for some, she seemed to serve the role of a surrogate parent or confidant. Many of the seniors have had her as their math teacher since freshman year. As was documented several times in my observational notes, Ms. Turner developed very meaningful and intimate bonds with some of the seniors in the

pre-calculus class. Students trusted and confided in her. For instance, one of the seniors, Frankie, was often seen talking to Ms. Turner during lunch or after school about her complicated and ever changing home life. From the bits gathered during those conversations and from what Ms. Turner told me, it seemed like Frankie, during her senior year, was juggling a mild to severe mental illness, a difficult relationship with her mom, and catching up on academic credits in order to graduate on time. She was often seeking counsel from Ms. Turner pertaining to how to deal with her mom or if it made sense for her to move to Arizona where her father supposedly resided.

This was also true for students in her other math classes. During her prep periods, it was customary to see individual or small of group of students coming into Ms. Turner's classroom and stopping at her desk for reasons unrelated to mathematics or with no direct connections to academics. Some of those interactions, especially when it was a group of students, were casual, light-hearted, lively and relatively brief. The instances where it was one student in the room with Ms. Turner, the interactions tended to be more tense and quieter. For example, Elena, a junior enrolled in the college pipeline program, confided into Ms. Turner during one of those walk-ins that she was absent because she had to find a shelter to stay with her siblings. According to what Ms. Turner told me during one of our meetings that went off track, Elena was being sexually abused by a family member at home. Apparently, Ms. Turner alerted the authorities and had Elena removed from her home. This caused some friction between Ms. Turner and an Oxford's counselor because it appeared that the school failed to properly document Elena's case; the counselor was also blamed for not devising an adequate and timely action plan.

Ms. Turner also played the role of matchmaker between students whom she thought would make a good couple or would be good for each other. She told me about one of those instances during the last few weeks of the 2015-2016 academic year. A few weeks before the senior's prom night, she engineered a match between two students in the honor's pre-calculus class whose personalities could not be more polar opposites.

> Ms. Turner was elated to have played the role of match maker and getting two students to agree to go the prom together. She told me that she noticed that Amanda and Tyronne liked each other and always tried to sit near each other in class. She spoke to Amanda and found out that she liked Tyronne but wasn't sure if he liked her enough to take her to the prom. She nudged Amanda—she's a very well behaved and hard working student—and semi tricked Tyronne—he's a bit self-centered and loud—to be each other's prom dates. She said that after speaking to Tyronne about his feelings for Amanda, she purposely asked Tyronne in the middle of a class full of students 'do you have a date for the prom?' After he (timidly) said no, she then asked Amanda if she had a date for the prom. Amanda said no. So, Ms. Turner said almost immediately 'why don't you two go together?.' According to her, they said yes or ok. (Field notes, Mon 04/04/16).

In fact, at times, it appeared that Ms. Turner delighted more in the relational or "softer aspects" of teaching over the more technical ones (Edin and Nelson, 2013, p. 222). In other words, she seemed to be more comfortable, more purposeful and more impactful when engaging students about the non-academic aspects of their lives as opposed to helping them make sense of pre-calculus topics like complex numbers. In fact, a couple of months before the end of the

academic year, Oxford's principal told Ms. Turner that he needed to add AP calculus to the list of math courses available at the school. He wanted Ms. Turner to teach the AP calculus class. She seemed bothered and anxious about the thought of teaching calculus at Oxford and thought that the principal was making a mistake because, in her estimation, there weren't enough juniors with the mathematical skills necessary to learn calculus (Field notes, April—May, 2016). Ms. Turner told me about a former Oxford teacher of a few years back, a graduate of an ivy league university, who taught calculus one year and decided not to come back because of that experience. She was adamant that the principal was putting teachers and students in an untenable position.

This is a phenomenon described in Edin and Nelson's (2013) ethnographic study of low-income fathers from struggling communities like Philadelphia, Newark and Camden whose low job prospects and persistent economic woes forced them "to emphasize those aspects of the father role [like going to the park, or buying toys] they can most reasonably fulfill" (p.223) over that of the breadwinner and provider. The authors argued that many of the men interviewed perceived being a father, in the more traditional sense, as untenable. In Ms. Turner's case, her conviction that the majority of students from Oxford, including the juniors and seniors from her honor's math classes, were mathematically deficient, rationalizes and legitimates valuing time spent playing the role of a surrogate parent or counselor over that of a math teacher. This was evidenced and highlighted in many of my field notes:

> There were three seniors, Tamika and two other girls, with Ms. Turner. They were just chatting about life, life outside of academics. Ms. Turner always felt so much in her

> element, so relaxed, and so captivating when she was relating to or engaging students in non-academic aspects of life. She never seemed annoyed or frustrated and similarly, students were always attentive and interested. (Field notes, Thur 05/26/16).

She was often surprisingly comfortable and seemingly effective talking to students about very difficult life circumstances such as sexual abuse, home insecurity, death of loved ones, and violence but would cower at or resist the thought of raising expectations and standards for how students experience pre-calculus and algebra II. Ms. Turner embodied and exhibited genuine compassion and concern for students' well-being rooted in a mostly deficit-oriented set of beliefs about their academic potential and prospects.

Profile of participants

The eleven seniors selected for this study were recruited during Oxford's second academic quarter. By then, I had begun or established a relationship with every participant; I was aware and made note of students' in class behavior patterns, relationships with fellow classmates, college and career aspirations, and general disposition vis-à-vis pre-calculus and mathematics. This helped me develop a brief profile for each participant. This was useful in attempting to understand each student's perception and identification with mathematics.

Table 4.1 Overview of participants' profile

Name	Interpretation of Math Experience	Math Identity	Perception of a Math Person	Racial Identity
Kawhi	1) Mostly Positive 2) Never struggled in math; math is his most comfortable subject	Always identified as a math person, a very logical person	1) Someone who's very logical and possesses a natural aptitude for numbers 2) Could not identify any other seniors as math people	Defined being black as a fight against the odds
Nigel	1) Mostly Positive 2) Showed little interest in honor's pre-calculus	Always identified as a math person	1) Someone born with a natural aptitude for numbers 2) Could not identify any other seniors as math people	Did not know how to answer; however, he insisted that he was "not different"
Kendrick	1) Mostly positive	He did not identify as a math person during the time of this study	1) An exceptional thinker	Perceived being black as proving them that you're "normal"

Table 4.1, continued

Name	Interpretation of Math Experience	Math Identity	Perception of a Math Person	Racial Identity
Stephanie	1) Mostly negative in spite of history of success in math	Never identified as a math person; she viewed mathematics as a bunch of rules	1) Someone who knows all the rules and knows when to apply them	Defined being black as needing to be better than average
	2) Performed well in honor's pre-calculus		2) Could not identify any other seniors as math people	
Tamika	1) Mostly negative in spite of history of success in math	Never identified as a math person; she believed to be too creative for math	1) Someone who knows all the rules and knows when to apply them	Defined being black as having to exceed expectations
	2) Performed well in honor's pre-calculus		2) Could not identify any other seniors as math people	
Tyronne	1) Mostly positive	He still believed to be a math person during the time of this study	1) Someone who's exemplary in math	Identified as black with some group of friends and Jamaican with others—he was born in the U.S.
	2) Struggled in high-school math; he did not believe to have received a quality secondary math education		2) Could not identify any other seniors as math people	
Shalik	1) Mostly positive	He did not identify as a math person during the time of this study	1) Someone who can solve most problems thrown at them	Defined being black as a fight against the odds

Table 4.1, continued

Name	Interpretation of Math Experience	Math Identity	Perception of a Math Person	Racial Identity
Andre	1) Mostly positive 2) Showed little interest in honor's pre-calculus	He still believed to be a math person during the time of this study	1) Someone who has passion for learning and doing math 2) Believed every senior was a math person	Defined being black as a fight against the odds
Victor	1) Mostly positive 2) Showed little interest in honor's pre-calculus	He still believed to be a math person during the time of this study	1) Someone who understands the basics 2) Could not identify any other seniors as math people	Defined being black as needing to be better than average
Felix	1) Mostly Positive 2) Showed little interest in honor's pre-calculus	He still believed to be a math person during the time of this study	1) Someone who just knows it 2) Could not identify any other seniors as math people	Did not know how to answer
Weldon	1) Mostly Positive	Always identified as a math person	1) Someone who understands the basics	Defined being black as having to exceed expectations

Kawhi

Kawhi is originally from Baltimore, Maryland and attended elementary and middle school there. Kawhi spent his entire K to 12 education in urban public schools very similar to Oxford. The only notable difference, he pointed out during his first interview, is that Oxford, 57% Black and 33% Hispanic, was his first time in a racially diverse academic institution. Kawhi said that he grew up in a family who was relatively strict and challenged him to do well academically. He described himself as a very logical person and attributed his success in mathematics classrooms and his interests in pursuing a math-focused career to this character trait. In class, he sat alone, away from most of his peers and rarely spoke. He only interacted with Felix, another participant in this study, over Lacrosse and other sports related events. Kawhi believed that his race became salient in his understanding of the world around him in middle school, after reading about the killing of Emmettt L. Till[4]. He explained during his second interview that this was when he realized that his skin color played a significant role in how the world reacted to him. Kawhi defined being black as being tasked with beating the odds. He is acutely aware of the racial stereotypes surrounding math education. In an attempt to combat those stereotypes, Kawhi seemed to have developed an alternate reality of the world. For instance, he told me that he had read and believed that many well- known mathematicians and scientists like Albert Einstein were of African origins. He believed math to be his favorite and

[4] Emmettt Louis Till (July 25, 1941 – August 28, 1955) was an African-American teenager who was lynched in Mississippi at the age of 14 after reportedly flirting with a white woman. The white men who killed him were all acquitted.

easiest subject; however, he had difficulty conceiving of himself as being a member of the community of math learners and doers. He also struggled identifying any seniors (other than himself) as math people.

Nigel

Nigel was one of Oxford's most popular seniors. He was also a member of the school's football team. There was an article in a local newspaper about his gifts as a football player and his potential as a college prospect. Ms. Turner showed me the article; later that day, she told Nigel that she saved the newspaper for when he turned pro and became famous. He walked around with an almost palpable air of self-confidence and self-importance. He mostly wore hoodies and loose-fitted jeans or khakis. Nigel never seemed in a hurry to get anywhere or begin anything. A handful of students, among them Andre and another female student from the honor's pre-calculus class, were often seen tailing him. He believed mathematics to be his favorite subject and believed to be born with a natural aptitude for numbers. When asked about his struggles and seeming disinterest in honor's pre-calculus, he said that he was tired and did not really need the class to graduate. Nigel said that he grew up with a mother who stressed daily that he was not to believe in any of the negative stereotypes about African Americans. He said that was one of the main reasons he was a straight A student until his senior year. He believed to be a math person. However, like Kawhi, Nigel couldn't identify any other seniors in Ms. Turner's class as math people.

Kendrick

Kendrick was born in Jamaica and had been in the U.S only three years during the time of this study. He described his experiences in elementary and middle school math classrooms as very successful. He and a handful of other students were always given more advanced or tougher math problems. Kendrick struggled with pre-calculus; in fact, he had trouble with mathematics during most of his secondary education. He attributed his struggles in mathematics to the fact that he did not have a math teacher or any math instruction during his freshman year at Oxford. At the beginning of this study, he was certain that he did not want to go college. Kendrick wanted to be a fireman and could not understand why he needed a college education. By the end of the study, he had changed his mind and enrolled in a local community college and majored in Fire Science. However, he was concerned about the college's math placement exam and subsequent college math courses required for his major. Kendrick said that he did not think about race before living in the United States. In fact, he believed that racism or being treated differently because of one's race was a thing of the past. During his second interview, he explained that being black meant proving others that he was "normal" and could achieve what they have achieved. He was one of the two participants who was able to name other seniors as math people.

Stephanie

Stephanie appeared to be one of most studious students in the class. In class, she was often on task and worked earnestly to complete her independent practice problems. Stephanie and I got along almost immediately. She was not shy about asking for help; nor was she ever

afraid to question or challenge mathematical concepts that she struggled wrapping her head around. She was certain that she was not a math person in spite of her successes in honor's pre-calculus and in previous math classes. She described being black as a constant fight to prove the world otherwise. Stephanie discussed the pressure she felt in classrooms with students from other racial groups to not give legitimacy to negative stereotypes about blacks. In one of our informal conversations, she said that she was accepted to a number of colleges across Pennsylvania but would probably not venture too far away from Philadelphia because she did not want to be among mostly whites. Stephanie was a performing artist and was conflicted between obeying her parents, choosing a more practical major in college, and pursuing her passions. She also was not able to name anyone in the honor's pre-calculus class as math people.

Tamika

Tamika considered by peers and Ms. Turner to be the most studious and focused student of her graduating class. Tamika was accepted to several colleges but routinely complained about feeling unprepared or unequipped for college. She believed students were deluding themselves in thinking that academic successes at Oxford would translate into college and professional success. Tamika was extremely concerned about her future and was careful to not engage in anything or befriend anyone that could jeopardize her chances at realizing her dreams. For instance, I never observed her talking or joking with Nigel or Andre or any other seniors in the class who, in her eyes, did not appear to take school seriously enough. I learned from Ms. Turner that after Tamika heard that her prospective college roommate suffered from a severe mental health problem, she

contacted the school and requested to be moved elsewhere. She was concerned that her roommate's condition would adversely affect her academic performance. Tamika said that she never thought of herself as a math person. When asked to reconcile her success in mathematics classrooms and her disinterest in the subject, she answered that math was always something she 'had to do to get to where she needed to go.' She also said that she did not know anyone in the honor's pre-calculus class who was a math person. Tamika even dismissed the fact that Weldon was Oxford's Valedictorian as meaningless and just the end result of teachers helping students during in class exams.

Tyronne

Tyronne described his overall experience in mathematics classroom as mostly positive. In fact, he recalled being the "example kid" in elementary school. Tyronne struggled his senior year in nearly every subject, but particularly in pre-calculus. However, by the time of this study, he still identified as a math person. When asked about his struggles in pre-calculus, he said that grades did not mean anything; he believed getting good grades simply meant knowing 'how to play the game.' Tyronne, like Kendrick, argued that his struggles in math as a senior and throughout most of his secondary education was due to the two years spent in an alternative public school for behaviorally challenging kids. He was also concerned about college and did not think he could ever do well enough in any college math placement exam to get admitted. As a result, Tyronne chose to go the navy and decided not to apply to any colleges. He also acknowledged the existence of negative stereotypes associated with being African American.

During our second interview, he confided in me that depending on the group of friends and social setting, he identified as Jamaican instead of black. I asked him to explain and he replied that his great grandfather was Jamaican. So, in spite the fact that Tyronne was born in the U.S., in some circles he felt compelled to highlight his Jamaican heritage and hide his racial identity. He also was not able to name any other seniors whom he thought of as math people; however, he named a student who was not the in the honor's pre-calculus as a math genius.

Shalik

Shalik seemed to always be with Stephanie. They were both performing artists and took dancing classes together. Shalik appeared to be very attentive in class. He volunteered to answer questions aloud and on the board. However, when presented with a math problem, his instinct was to say "I don't know how to do this." After guiding him a little bit or reminding him of a concept, he was always among the first students to complete the task in question; he never missed an opportunity to show the class what he knew. This became one of our inside jokes. Shalik was mostly quiet and only interacted with Stephanie. There were some days Shalik would simply put his head down for part or most of the class period. When asked, his answer was always that he did not 'feel good.' It never felt like he was trying to elude work. It appeared to me that even when smiling or joking, Shalik was burdened by a deep sadness. Like Tamika, Shalik was skeptical of the pre-calculus class being labeled "honor's." He thought that students were in the class because Oxford had to offer an honor's class and that they were the best the school could do. He said that he used to identify as a math person but no longer did and was not

interested in pursing anything that required him to enroll in more advanced math courses. Shalik wanted to be a performer but was unsure on how or where college fitted into his plans. He was very aware of the negative stereotypes associated with being black and math education. In fact, while he believed that people should not be judged based on their appearance, he was also convinced that no one in the honor's pre-calculus class was a math person because of the community they come from and the school that they attended.

Andre

Andre was described by Ms. Turner as 'once a very good student.' Andre was late to class very often. As mentioned earlier, he was mostly seen following Nigel. Andre was a very capable math student and was aware of it. He saw himself as a math person and conceded during his first interview that his poor grades in the honor's pre-calculus class were simply the result of not trying hard enough. He also walked around with an unmistakable air of self-assuredness. However, he was never defiant. Even the times when Ms. Turner summoned him publically to move to the front of the class, Andre would comply without much resistance. He described a math person as someone not only successful in mathematics classrooms but also passionate about it. He, like Kendrick, was among the few participants of this study to identify other seniors as math people. In fact, Andre thought that every senior in the class was a math person but he could not be certain that they had passion for learning and doing mathematics.

Victor

Victor seemed to be friendly with almost everyone in the class. However, he often

partnered with Kendrick during independent practice time. Victor was a jovial, personable and humorous student. He was also quick to laugh at others' jokes or simply at others' expenses. Victor and I got along fine from the beginning of this study although we had a very unpleasant exchange one day for no good reason. He was not doing any work and I asked him to get back on task; he replied that I was not his teacher and should not be talking to him. We talked about the incident and we both quickly forgot about it. As a senior, he did not seem like a very hard working student. On a few occasions, during instruction or group work, I caught him copying homework for other classes from Kendrick or other classmates. He blamed some of it on the fact that he worked full-time as a manager at a fast food restaurant near Oxford. He, like most of the participants in this study, had mostly positive experiences in elementary and middle school math classes. During his first interview, he said that he thought of himself as a math person but was not interested in the kind of math that astronauts were required to know. Victor said that he wanted to be a police officer and the thought of putting time and effort in advanced math seemed a complete waste of time. As a result, he planned to attend a local community college in order to satisfy the college credit requirements to join the police force.

Felix

Felix had the lowest attendance rate among the participants selected for this study. His attendance was much better during the first and second quarter of the academic year. However, for the second half of the school year, he was absent a lot and often for no good reason. Felix was a very well mannered, kind and likable student. He mostly interacted with Kawhi and another female student who was not a participant in this study. Felix was also a very capable

math student. In spite of his spotty attendance, he was often able to keep up with even the most abstract concepts in pre-calculus. Like the other students in this study, he did very well in mathematics during most of his K to 12 education. Felix and I talked about sports quite a bit, especially basketball. He thought that he was a very good basketball player; I would tease him that he was not good enough to play me one-on-one. We toyed with the idea of meeting up on the weekends to play basketball. It never happened. Felix is also a bit shy and uncomfortable sharing his views; I found this out during his interviews. He was not at all comfortable with the interview process and mostly produced very brief and at times unclear answers. When pressured to elaborate on or clarify a point, he tended to repeat himself or simply replied "I don't really know."

Weldon

Weldon was the last senior interviewed for this study. Every time we scheduled an interview day and time, he was either absent or wanted to stay in class to catch up on work that he had missed. So, I was forced to do both his interviews in one seating. Weldon's attendance was not as bad as Felix's but he missed a significant number of days during the last two quarters of the academic year. He, like Victor, blamed it on work. I was not sure of the kind of work he did or if he was really working. In spite of that, Weldon was considered a model student. He was probably Ms. Turner's favorite and was Oxford's Valedictorian. He struggled all his pre-teenage and adolescent life with his weight and self-esteem. He told me that in middle school, a teacher said that he was never going to amount to anything. Weldon included that moment in his college

essay in order to explain the roots of his drive to succeed. He got accepted into a number of colleges but decided to enroll into a local community college instead. He said that he wanted to be a nurse and did not see the point of wasting money to go to a fancy school far away. He believed that he was still a math person and like the other participants could not identify any other seniors as math people. Weldon identified as black but stressed during our interview that he was "bi-racial;" his mother is white and his father African American. He was uncomfortable talking about race; nevertheless, he did echo everyone else's sentiments that being black meant having to go beyond expectations.

Impact of Accumulated Math Experiences

Students' accumulated experiences in mathematics classrooms played a significant role in their perception and interpretation of their overall math ability and performance in the honor's pre-calculus class observed for this study. This was especially evident in students' reflections about their experiences with mathematics from grade one to their freshman year of high school. In fact, this study's findings showed no variability between high achieving 12th graders, confident in their math ability and low-achieving, low confidence students. Nigel, a high achieving, confident math student, and one of the few seniors of the 2016 graduating class at Oxford high school who passed the Algebra I Keystones exams as a freshman, summed up his experiences with math below:

> As far back I can remember, I always like math. I ain't never had problems with it. I never really like gave up on learning it. Say if I didn't know something, I never really stopped. I just kept going till I learned it. Like I'll get mad sometimes but I still go in and try to get it. Overall, I always just got it at the end.

Similarly, Kendrick, a struggling student with very low confidence in his math ability as a senior and prospective college student, and who routinely complained about the difficulty level of the honor's pre-calculus class, described his middle school experiences in mathematics classrooms very much like Nigel's,

> back in middle school, I was pretty fast with this stuff. Like [the teacher] could give me a problem that she didn't go over yet, like an advanced one and I could look at it, and know what to do and get it right. Like me and one of my friends, we used to get more advanced problems on the board to do.

Seniors on both ends of the ability and confidence level continuum, not only felt positively about their overall experience in mathematics classrooms, but described elementary and middle-school math as "easy." Some participants went further and interpreted their success in pre-Algebra level math as evidence that they were "always good with numbers" (Feliz, D., interview, 04/04/16).

As a result, many of those seniors who had difficulty with the honor's pre-calculus class and scored poorly on most in class assessments, attributed their low performance to 'senioritis,' lack of effort and motivation. According to Nigel, it was unfair to use his performance in Ms. Turner's class as a gauge or an indicator of his math aptitude or level of interest in the subject.

He believed that his low performance and seeming disinterest, along with other seniors' performance, in the honor's pre-calculus class were largely due to the fact that they had already fulfilled their credit requirements in mathematics for graduation and that Ms. Turner's class was an elective with no real impact on their college prospects. He expanded upon this during our second interview:

> Yeah, I already proved myself so I feel like I don't have to [as a senior]. I gotta rest because of all the stuff I've been pressured [to do] over all these years, all these extra stuff. So, senior year, pre-calc, I don't need it but I'm gonna do it because I have to do it.
>
> Researcher: Was it the same as a junior?
>
> Nigel: No, I had straight A's

Thus, the majority of the seniors who participated in this study thought of themselves as good in math or as having had positive experiences learning and doing math, especially as it relates to pre-algebra level of mathematics. Moreover, their perception of themselves as good with math delegitimized their low scores and lack of effort in the honor's pre-calculus class and dismissed their struggles in math, senior year, as more of a consequence of institutional and curricular failures.

Two out of the 11 seniors interviewed for this study, Stephanie and Tamika, summed up their overall mathematics experience in elementary school through their senior year diametrically opposite that of the other participants. They both described their K to 12 math experience as a "struggle." Stephanie, confessed that she "…always struggled with math period. Even in

elementary school [she] struggle" (McL., Stephanie, interview, May 9th, 2016). Tamika harbored similar sentiments about math and claimed that:

> since [she's] a girl, when it comes to like shopping and stuff, then it's different. But when it comes to like the formulas or everything, [she] just doesn't like it.

However, contrary to their perception of their K to 12 experiences, they were thought of by most of their peers and Ms. Turner as very good math students. In fact, during most of my visits in the academic year, Stephanie and Tamika were among the few seniors attentive during mini lessons; they frequently contributed to in class activities and discussions; during group activities, they were often responsible to explain or clarify a new concept or procedure to their fellow group mates; moreover, their homework assignments were nearly always completed and submitted by the deadline, and both scored well above the class grade point average on most quizzes and tests (McL., Stephanie & S. Tamika, field notes, 09/2015—06/2016). Tamika expanded upon this seeming paradox between her perception of her experience in math education and her actual performance during our first interview:

> Even though I don't like it, I wanna go to college and I have plans afterwards. So, I don't know. I think that I'm just trying to force myself to kinda deal with it. I don't have to like it, I don't have to love it but I know that I have to get through it. So, when I don't understand it, I just ask Ms. Turner or whoever else is there, 'can you put it in a different way so that I can understand it.'

Stephanie rationalized her perceived "struggle" and actual success in mathematics by conceptualizing the latter as an academic domain unlike others in that you're either a *math*

person or you're not. During our second interview, she argued that "you have to study math because math is just one of those subjects where it's either you like it and you know or you hate it and you don't. And if you're one of those type of people that don't like it, I feel as though that you have to study" (McL., Stephanie, interview, June 7th, 2016). In other words, she believed that some people simply possess a natural aptitude for mathematics and others don't and therefore need to compensate with a lot of effort in order to succeed.

The critical point here is that seniors' accumulated experiences in mathematics informed, shaped and provided meaning to their perceived math ability and performance in the honor's pre-calculus class. Students, like Nigel, Kendrick and Felix who had mostly positive experiences in pre-algebra level math viewed their poor performance, senior year, as a response to or a consequence of ineffective institutional practices such as being placed in an advanced course, senior year, that had no bearing onto their graduation or academic future. They interpreted their poor performance, lack of motivation and disengagement as the end result of institutional and programmatic failures and not as a reflection of their math ability or their motivation to learn and do mathematics. On the other hand, students like Tamika and Stephanie who interpreted their accumulated math experiences as mostly negative viewed mathematics, whether it is arithmetic or pre-calculus, as an academic domain that they "don't have to love but…know [they] have to get through" in order to get to college and realize their dreams.

This finding challenges the extant literature on math education as it relates to black students' accumulated math experiences, their math ability and its relationship to their motivation to learn (e.g. Martin, 2012) . Firstly, this study's focus on an honor's pre-calculus

classroom in an urban, comprehensive and under-resourced public school of predominantly black students from low-income communities sets it apart from the preponderance of studies in the field. It provides a counter-narrative to the "dominant framings and storylines about Black children and mathematics [that] have grown out of a race-comparative approach" (Martin, 2012, p. 48; see also McLoyd, 1991). An approach in which black students' performance in mathematics has been documented, evaluated and constructed in relationship to "other children…particularly White children whose mathematical behaviors and outcomes are normalized as the standards for all children" (p. 48; see also Johnson, 1984; Lubienski, 2002; Martin, 2007b, 2009a, 2009d, 2009e; Secada, 1992; Strutchens & Silver, 2000; Tate, 1997). Thus, this study, not only challenges the mainstream perception of the "failure [of black students in math] as normative," it provides "stories of high achieving black students who have productively climbed the mathematics ladder" (p. 49). Secondly, the fact that students' mathematics overall experience informed their perception of math ability and interpretation of math performance underscored the need for more studies to focus on students' perspective of learning and doing mathematics. It also stressed the need for a reevaluation of institutional practices and curricular designs that only allow "fewer than 10 percent of American children [to] complete the sequence of high school mathematics—algebra, geometry, trigonometry, and pre-calculus—that are required in many other countries" (McGee & Martin, p. 48; see Schmidt, 2003).

What does it mean to be "A Math Person"?

Students' accumulated math experiences also shaped their definition and conception of what constitutes a *math person*. Students' responses to how they defined a math person were based on their individual experiences and were mostly divided into two interrelated categories: {list them here]. All the participants of this study viewed a math person as someone "good with numbers" who knew the "basics." However, a subset of three participants extended that definition by adding that a math person is "a great thinker" or a very logical person.

A math person knows the basics

The participants for this study, in spite of their varied mathematics ability and confidence levels, shared similar views on what it means to be a math person. They believed it is someone who had mastered the basics or fundamentals necessary for succeeding in math. Weldon, a high ability and confident math student, and Oxford's valedictorian for the 2015-16 academic year, perceived a math person as "someone that know how to do the basic" and also capable of using their knowledge of the basics "to do the math that [they] haven't been taught yet" (Weldon, interview, May 2016). These beliefs were echoed by Victor, a struggling senior with low confidence in his ability to succeed in advanced mathematics courses. He viewed a math person as:

> Someone who can do the basics, who's gonna work out the problem, who's gonna finish the problem and someone who doesn't have to ask someone else what's the answer to do this.

Victor and Weldon added an important characteristic to the concept of a math person as someone who knows the basic. They extended the definition to one who possesses the ability to use their knowledge of the fundamentals to "work out" problems, even problems containing "math [they] haven't been taught yet." This was expanded upon during Shalik's first interview:

> Shalik: To just be able to figure a problem that's given to you, no matter what it is with radicals, variables. If you're able to break it down to where you get your answer, then you're a math person.
>
> Researcher: So, a math person is someone who gets the answer right every single time, you would say.
>
> Shalik: Basically they understand it cause it's not hard, I mean cause it's not easy to understand it.

Shalik furthered the concept of a math person by defining it as having the ability to "break down" and solve math problems regardless of the level of difficulty and abstraction. His math person is both knowledgeable of the fundamentals and understand or is able to "figure out" how more abstract mathematical concepts (like solving radical equations) relate to and build upon the fundamentals (of solving linear equations with one variable). This is similar to how Harel (2008a) defined mathematics and what it means to learn and do mathematics. As a discipline, he argued that mathematics consists of two categories, namely "ways of understanding" and "ways of thinking" about mathematics. Harel (2008b), an expert in the field of epistemology and cognition of mathematics, defined the discipline as: "a collection…of particular axioms, theorems, definitions, proofs, problems and solutions…[a collection] of all institutionalized ways

of understanding in mathematics" coupled with our natural, built in "ways of thinking" (p. 8). In other words, the seniors' definition of a math person as someone who knows the basics can be construed as being knowledgeable in some of the "institutionalized ways of understanding in mathematics." And, what Wendon, Victor, and Shalik added to this definition is the math person's ability to use their own ways of thinking to apply those institutionalized ways of understanding to solve math problems with varied levels of difficulty and abstraction.

This perception of a math person as someone who knows and can use the basics was even shared by Stephanie and Tamika, the only two seniors in this study who summed up their overall mathematics experience as a struggle. Stephanie defined a math person similarly to the other participants. However, she argued that the collection of particular theories that one needs to know in order to succeed in mathematics classrooms was the chief reason why she never conceived of herself as a math person:

> I feel as though a math person, I'm not saying that you get it right away but once they get the concept of how to do it, they always gonna know how to utilize it. I'm just, I just don't, I can't.

Her perceived, never ending struggle in mathematics is attributed to what she characterized as an inability to master the institutionalized ways of understanding in math well enough to "know how [and when] to utilize [them]." Stephanie's difficulty with math does not really have anything to do with her ability to perform well in the subject. As stated previously, she is one of the top students in the honor's calculus class and is thought of by her peers and teachers as a very good math student. She appeared to locate her perceived history of struggle in not being able to

"always" know "how to utilize" the collection of institutionalized ways of learning and doing math. Her main problem seemed to be using her own ways of thinking, the second construct of Harrel's (2008b) definition of mathematics, to make sense of or make use of the academic domain's more specific and technical ways of understanding. She expressed those thoughts at the end of our first interview:

> You know I just never understood uh math in general. People always say why do you do this? I would do it because that's what I was told to do and I ended up getting the right answer but I never knew why do you do this, where is this coming from, how do we know?

Similarly, Tamika's view of her experiences in math classrooms as mostly negative prevented her from perceiving herself as a math person in spite of regularly obtaining good grades in the honor's pre-calculus class. However, unlike Stephanie, Tamika believed that she was not a math person because she was "too creative with [her] thoughts" (Tamika, interview, March 2016). And that mathematics as an academic domain did not seem to offer many opportunities for students' creativity and own curiosities. Tamika acknowledged that she was among the highest performing students in the honor's pre-calculus class but said that it had nothing to do with her math ability or she being a math person;

> Researcher: Ok. Any point between K and now, even if it's like a semester, a year or a month that you felt like maybe I'm a math person?
>
> Tamika: No. No

Researcher: Never?

Tamika: Never

Researcher: Even if you got 100% on a test?

Tamika: No, I just think that I studied as hard as I could and I got a good grade.

The critical aspect of this finding is that two high achieving and high ability math students like Stephanie and Tamika are unable to see themselves as math people because of their cumulative experiences learning and doing mathematics and their subsequent perception of mathematics as an academic domain with a bunch of "rules" and little room for creativity.

A small subset of the seniors selected for this study who shared the other participants' beliefs that a math person is someone who knows the basics, added that it was also someone who is "good with numbers." Nigel used his mostly positive experiences in mathematics classrooms to explain why he perceived himself as a math person and how he came about that realization,

> Like you know it as a child. You're good with numbers or you're not. I always was good with numbers, money, anything. I just knew how to do it. I don't know how. I ain't gonna lie, I ain't really study. Like I just like go and do it.

He, like many of the other seniors from the honor's pre-calculus class, believed that being a math person is a character trait, a biological fact independent of institutional and instructional factors and practices. Nigel couldn't provide any explanation for why he was good with numbers and money other than he just knew "it as a child." Similarly, Kawhi, a high ability and high confidence math student, and the only senior to score high enough in Cecil Moore University's pre and post math college placement exams to be placed in calculus as a college freshman,

viewed a math person as someone born with a facility for economics and finance. During our first interview, he explained in great details what he meant by a math person is someone good with numbers:

> Probably sophomore year when I was thinking more about what I wanna do when I get to college. I was like what do I wanna do? I've always had a thing with money. Like my family has always had kinda up and down issues. Like my uncle has a lot of money but my mom doesn't. So, it's like I see both sides. So, I think about what does that break down to. Managing money, what does that break down [in terms] of jobs and everything else. I came down to well what am I good at? And I mean I think I kinda realize ultimately that accounting probably fits me well because I'm good at math.

Kawhi described mathematics as a gateway to both economic and professional success. From his perspective, a math person is one born with a natural aptitude for numbers. It is someone suited to pursue and succeed in math oriented careers such as accounting, thus, likely to lead an economically stable life because of their acumen for managing money. He believed his uncle's good fortunes and his mom's financial struggles are living examples of a math person as someone "who always had a thing with money" and on how mathematics plays a significant role in one's life chances. This has been a concern for many social scientists and educational researchers since the 1970's who have characterized mathematics as a gatekeeper precluding certain social and racial groups from professional and economic opportunities (i.e. Beane, 1988; Catsambis & Beveridge, 2001; Freitas, 2008; Moses & Cobb, 2001; Pelavin & Kane, 1990;

Sells, 1973; Tate, 1994). This concern has persisted in the 21st century. For example, Catsambis and Beveridge's (2001) analysis of U.S. census data combined with data collected from the National Educational Longitudinal Study (NELS:88) found that "relationship between mathematics achievement and future academic success is more pronounced for African American and Latino students" (p. 21). And since mathematics has been established as a high-status discipline, necessary for economic prosperity, it is perceived by many as "playing a pivotal role in the social structuring" of the lives of racial minority students, like Kawhi and Nigel, who are from under-resourced communities and are enrolled in low performing neighborhood schools like Oxford (Freitas, 2008, p. 43; see also Moses & Cobb, 2001).

A Math Person is a great thinker

Another important aspect of students' definition of a math person as one who knows the basics, who is good with numbers is that such a person is unlike the average person or student. This was a common belief among the seniors who participated in this study regardless of the nature of their overall experiences in mathematics classrooms, and independent of their confidence and ability level. For instance, Kendrick, who described his elementary and middle school experience in math as mostly positive, but ranked amongst the lowest performing and least confident seniors in the honor's pre-calculus class, believed that a math person is "a great thinker." He expanded upon this concept during our first interview:

> A math person is like a thinker. Like you gotta look at everything the person taught you, even if you're not doing that at that point, like if you're doing square root or something, like you got a problem that's not talking about square root but you gotta take the square

> root of it like to get the answer. You gotta know like everything that they taught you up to this point. Sometimes you gotta know little more than one step to finish a problem, you know what I'm saying. So, sometimes you gotta look at it and [be] smart, think what you need to do to get the answer. So, I think that a math person is a great thinker

In Kendrick's definition, a math person needs to know all the institutionalized ways in thinking about mathematics and should possess the ability to devise problem solving strategies specific to a given mathematical task. He conceded during that interview that he no longer thought of himself as a math person because the content "kinda got harder" and that he didn't know enough of the institutionalized ways in thinking about pre-calculus. He did not feel confident in his ability to "look at [a problem] and [be] smart, think what [he] need[ed] to do to get the answer." Kendrick explained that his perceived inability to learn abstract and difficult contents such as solving equations with radical expressions (i.e. solve $3 - \sqrt{x + 2} = x$) stemmed from Oxford's failure to provide him quality math instruction or a competent math teacher during his freshman year. He believed that Ms. Turner's extended absence due to illness during his first year in high school robbed him of the opportunity to master the rules for learning and doing algebra necessary to handle an honor's pre-calculus class:

> Well, like I missed some of the stuff so probably some of the stuff that I should be thinking like the steps what to do maybe I'm not gonna be thinking about it cause I missed a little on my way. I missed some stuff

Kendrick's experiences in high school level mathematics and their impact on his perceived math ability were shared by Tyronne, another low performing senior in the honor's pre-calculus class. Tyronne also believed that institutional failures and larger social factors were responsible for the struggles and frustrations he endured as a senior enrolled in an advanced mathematics classroom. He hinted at "being caught up doing things outside of school" in middle school that distracted him from being able to invest adequate amount of time and effort needed to excel academically. As a result of this, Tyronne was sent to an alternative public school in the district specialized in "non-traditional educational options for out of school youth, students who are significantly at risk of dropping out, and students who are subject to disciplinary transfer or expulsion" (*The Opportunity Network*, The School District of Philadelphia). During our second interview, Tyronne summed up his two years at the alternative public school as "not really educational" and the main reason for his struggles in honor's pre-calculus:

> It's like…when we're going over things that I don't understand, and it just seems so foreign to me and I hear people say 'oh, I remember this from middle school' and things of that nature, I can't help but reflect on the days that I sat in my math class in middle school and did not do anything but watch the teacher break up fights. It was just like ok.

However, unlike Kendrick, Tyronne, still thought of himself as a math person, as a great thinker. He reconciled his low scores, lack of effort and interest in the honor's pre-calculus class with his lingering perception of himself as "the example kid… that teacher would call [on] and like come show your classmates" cultivated in elementary school in the excerpt below:

> Yeah, nah I feel like grades do not define like who you are in any way, shape, or

> form. Grades are just, like if you can play that game. Like me, I got so caught up in like things going on outside of school, I just lost the focus that I needed. But uh, I would still consider myself a math person

Kendrick and Tyronne represent illustrations of concerns shared by many scholars of urban education over the adverse impact structural forces, institutional and classroom practices have on students' overall academic performance, particularly in high status disciplines like mathematics (i.e. Anyon, 1997; Oakes, 1985, 1982; Oakes, Ormseth, Bell and Camp, 1990; Rachlin, 1988). In fact, one of the key findings in Oakes, Ormseth, Bell and Camp's national survey of the state of science and mathematics education across the U.S. is that black students, from low income communities and attending racially and socially segregated secondary schools like Oxford, were more likely to have less rigorous and less stimulating science and mathematics programs available to them (p. 9). Kendrick, along with other seniors in the study, have related their struggles in the pre-calculus class in part to institutional failures like not having a math teacher for the majority of an academic year or from accumulated negative experiences in math classrooms. This is often compounded by in school practices like tracking (Oakes, 1990) which can significantly alter the academic trajectory and life chances of a student like Tyronne from an example kid in elementary school to two years in an alternative public school where managing and correcting behaviors are given primacy over academic learning.

Kendrick's explanation for why he no longer conceived of himself as a math person was echoed by Shalik. The latter's mostly positive experiences in elementary and middle school

mathematics classrooms were also thwarted by an inability to think of himself as a great thinker within the context of the honor's pre-calculus class:

> Shalik: I felt like I was before but I'm not anymore.
>
> Researcher: You wouldn't call yourself a math person now?
>
> Shalik: No
>
> Researcher: But, the 6th grade you, in 6th grade, if someone were to ask you, 'are you a math person?' You would've said…
>
> Shalik: Yeah.
>
> Researcher: Why?
>
> Shalik: Because I understood everything. You could throw me a math at my grade level and I would be able to answer it.

And similar to Kendrick, Shalik, ceased to perceive himself as a math person because he didn't believe that he "would be able to answer" every pre-calculus problem thrown at him. However, like Stephanie and Tamika, Shalik was one of the highest performing, most studious and engaged seniors in the honor's pre-calculus class. His scores were almost always better than the class average in class quizzes and tests; he volunteered quite frequently to solve and explain problems on the board to the class; moreover, Shalik made frequent suggestions and asked thoughtful questions during in class discussions (field notes, 09/2015—06/2016). In spite of the overwhelming evidence of Shalik's high performance and high level of engagement in the honor's pre-calculus class, he remained convinced throughout the academic year that he was not

a math person, nor would he ever pursue any college majors or careers that require him to enroll in more advanced math courses.

This finding challenged the extant literature on the correlation between math performance and students' perception of their math ability. Psychologists, educational researchers and practitioners have long debated whether academic performance "and confidence go hand-in-hand" (Burton, 2004, p. 357). Burton (2004) argued that, in spite of the absence of a consensus on an operational definition for constructs like self-confidence, or self-efficacy among scholars, the belief that "success in mathematics breeds confidence" has dominated and still dominates mainstream beliefs about learning and teaching (p. 357). So, the belief that underpins and at times guides many studies concerned with correlating competence to students' feelings about a particular domain is that ability and confidence are linked and proportional. However, high performing math students like Tamika, Stephanie and Shalik whose success in mathematics in honor's pre-calculus had no positive impact on their perceived math ability is evidence that there is "need to gain greater insights into the ways…students speak about the construct of confidence, in what contexts they do so, and how they pair confidence with other notions, such as a sense of belonging or community" (Darragh, 2013, p. 218). Particularly in the case of students like Kendrick and Tyronne, both with overwhelmingly positive experiences in elementary and middle school math, and drastically different learning experiences in secondary education, it is critical for studies interested in the combination competence-confidence to be able to provide more nuanced and cogent explanations for those two students' starkly different views about their math ability, and confidence level.

All of the participants in this study expressed with some variability that a math person is someone above average. Kendrick used the phrase "a great thinker" to elucidate his beliefs that a math person is born with an unusual facility for learning and retaining all the institutionalized ways of thinking in mathematics, and developing effective problem solving strategies based on that knowledge. Similarly, Kawhi during our first interview said that he was a math person because of the type of person he perceived himself to be:

> When I think about it, I think to my personality which is weird. I think of everything logically. I don't really go into situations or talk to people or do certain things without having some kind of mental explanation. When I disagree with someone, when I say that doesn't make sense, and they tell me it doesn't have to. I'm like it kinda does…So, it's my personality. It's the only way that I can think

He believed to be a very logical person, governed by reason and who only makes decisions informed by logic. And because his accumulated experiences in mathematics classrooms have constructed this narrative that he "always had a thing with money," unlike the average student, he developed a perception of mathematics as an academic domain reserved for a selected few. Thus, it is only logical for Kawhi to have always excelled in mathematics and to desire to pursue a math oriented career path. Likewise, Tyronne, who was the example, exceptional kid in his elementary and middle school math classes, rationalized his low performance in the honor's calculus class as his decision not to or disinterest in playing the getting good grades "game." As a first grader, getting good grades in math meant that he was the example kid; and, as a senior, he

felt "like grades do not define like who you are in any way, shape, or form. Grades are just, like if you can play that game."

Students' view of a math person as someone born with extraordinary aptitude for numeracy and abstract thinking constitute a significant aspect of their confidence level and identity as learners and doers of mathematics. In some instances, like in the case of high performing seniors Shalik, Tamika and Stephanie, good grades in mathematics classrooms meant getting the right answer because they studied and remembered a set of specific rules. To them, success in mathematics has no correlation to their confidence in the subject, nor does it influence their perception of not being math people that they developed during the course of their K-12 education. In other cases, seniors like Kawhi, Nigel and Tyronne with vastly varied high school math experiences and performances, preserved their identities as great thinkers cultivated in elementary and middle school. What this finding suggests is that constructs like confidence in an academic domain is not fixed, nor is it the end result or root cause of success in the domain in question.

Math Confidence

It is evident, based on some of the findings discussed thus far, that students' mathematics performance and confidence constitute a more complex and layered relationship than the believed linear and proportional one that has dominated mainstream and scholarly views about education (Burton, 2004; Darragh, 2013; Hardy, 2007; Lerman 2009). Moreover, it is apparent that students' perception and relationship to mathematics, along with their identity construction in the academic domain, cannot simply be reduced "to cognition, achievement, or performance,

but rather…" need to be extended to "the whole person and how they 'become' a learner of mathematics" (Darragh, 2013, p. 216; see also Lerman, 2009). In this paradigm, borrowing from Hardy (2007), confidence "brings with it references to [larger] social practices" (p. 23), and is conceived as a sense of belongingness.

Most of the participants rated their overall confidence in mathematics very similarly. In fact, according to the data collected from the interviews' transcripts, more than half of the students gave themselves between an 80% and a 70% rating for their confidence in math. For instance, high performing students who identified as math people like Kawhi and Nigel along with struggling seniors like Tyronne rated their confidence a 7 out of 10. Meanwhile, Stephanie and Tamika, two high achieving seniors who never thought of themselves as math people rated their math confidence similarly to Kendrick who was among the lowest performing seniors in the honor's pre-calculus class.

However, the results from a self-reported *Survey on Mathematics Confidence* (Appendix D) administered to the honor's pre-calculus class in the middle of the second quarter (field notes, Jan 29, 2016) in order to accurately categorize students by self-confidence level, showed a much more varied confidence rating. The results showed that 3 participants' math confidence were between 80 and 70%, while two were at 50%, one was at 90%, one 0%, another one at 20% and three others were 40%. Furthermore, high ability students like Weldon, who rated his overall math confidence an 8 out of 10 during his interview, checked "not confident" or "a little confident" for 6 out of the 10 items on the *Survey of Math Confidence*. For instance, he checked "no confidence"' for items like " I will pursue careers that involve knowing and using some

advanced math concepts," and "I will likely go into careers that require a lot of college mathematics" but felt confident that "Math is one of [his] favorite subjects." Similarly, Stephanie said that her confidence level in math was 50% during the interview but was "confident" and "somewhat confident" about 80% of the items on the survey.

Results from the survey of students' math confidence and data extracted from participants' interview transcripts are displayed in the table below:

Table 4.2 Students' Confidence Levels

Participants	Confidence Level from Interview Transcripts	Confidence Level as Reported on Survey	Interview% - Survey %
Weldon	80%	40%	+40%
Kawhi	70%	90%	-20%
Tyronne	70%	40%	+30%
Nigel	70%	70%	0%
Andre	70%	0%	70%
Victor	70%	50%	+20%
Felix	70%	70%	0%
Kendrick	60%	50%	10%
Stephanie	50%	80%	-30%
Tamika	50%	20%	+30%
Shalik	40%	40%	0%

The discrepancy in students' confidence levels measured by the *Survey of Math Confidence* compared to how they rated themselves during their second round of interviews is striking. In fact, only two participants' confidence levels were consistent in the data collected from the survey and interview transcripts. This is further complicated by the fact that all 11 seniors selected for this study said that they did not perceive of themselves as belonging to a math community of learners and doers. This illustrates the complexity of theorizing about student's academic identity and confidence in a domain. Hardy (2007) argued that academic confidence is "not a state but a process…through which learners are constituted and through which, in often implicit ways, they constitute themselves" (p. 24).

A sense of belonging

High ability math students like Kawhi, who obtained the highest scores in Cecil B. "Moore" University's college placement exams, and Weldon, Oxford's 2015-16 valedictorian, were both unable to perceive themselves as members of the math community of learners and doers. This in spite of the fact that during the first rounds of interviews the two seniors stated that they were math people and always knew that they were good with numbers. Kawhi tried to explain the distinction between being a math person and being a member of the math community below:

> I'm just good at it. I'm not the type of person that's going into accounting because I love it. I'm going because the profession itself and the career itself is one that is comfortable with me at least socially as far as working with people, working with numbers, I'm comfortable…

Kawhi admitted to be “good” in math and “comfortable” contemplating and even pursuing mathematics oriented careers like accounting. He even alluded once again to his personality, his being a logical person as the reason for his success in math and likely career in a math dominated field. However, he also conceded that “I’m not the kind” of math person who sees themselves as part of a math community. This is a peculiar distinction in that it highlights a more nuanced and layered concept of identity, self-perception and membership for high ability and high achieving students like Kawhi. He elaborated on this further later in the interview:

> I mean I think for you to be someone like that, in that kind of community, you have to dive into it and be a part of it. Like, if you're thinking about a community situation, I mean it's coming together like that's the whole basis. Like the only communities that I have ever been a part of are ones that, that I dive into

Similarly, Weldon, one of the highest performing seniors in the honor’s pre-calculus class, believed to be a math person and was convinced that mathematics was his favorite subject because of his experiences in mathematics classrooms, but he didn’t see himself as a member of a math community of learners and doers. In fact, Weldon, during a conversation that took place after the conclusion of our second interview, told me that he had decided to register for an entry level college math course at a local community college even though his placement exam scores made him eligible for a much more advanced level course (Weldon, field notes, May 2016). Like Kawhi, Weldon tried to elucidate the distinction he made between being a math person and belonging to a math community;

> When [I say] I'm a math person, I just say like I'm a math person, I enjoy math. Like I

> enjoy coming to class and learning about what we're learning and learning new things. And I know that heads to work toward my future career. I need math in my life.

Here we have a high performing math student who acknowledged the joy he's derived from his experiences learning and doing mathematics, and its importance and relevance to his career aspirations and overall life chances. However, Weldon does not view himself as a member of the math community because of his decision to go into a nursing career instead of "go[ing] to school to be a math teacher." Both students took exception to the notion of 'belonging to a community.' When I pressed Kawhi on the subject, on why he couldn't see himself as already a member of a math community because of all his successes and the fact that he considered in majoring in accounting, he replied:

> I think that if I were a person who constantly was looking for new ways to develop in mathematics then I would come across more people that help me do that. That's really the only way that I can see because that's how I do a lot of things like as far as lacrosse.

Kawhi was a student-athlete at Oxford and was a starter on the school's lacrosse team. He told me that he had been playing lacrosse for two years and intended to continue playing in college. Kawhi had no trouble thinking of himself as a member of the lacrosse community. In fact, during that interview he shared his passion for the game, his perceived gift for playing and the countless hours spent on social media researching collegiate athletes and professionals whose style of play and careers he aspired to emulate. Kawhi used lacrosse to explicate his understanding of the notion of belonging to a community and how that differs from being good at something.

The nuanced math identities that emerged out of Kawhi and Weldon's descriptions and characterizations of themselves in relationship to mathematics is an illustration of what Sfard and Prusak (2005) labeled as *actual identity* and *designated identity*, two subsets of identity. The authors explained actual identity as "consisting of stories about the actual state of affairs" (p. 18). For instance, Kawhi and Weldon's actual identity is that of a math person, whose experiences in mathematics classrooms have been mostly positive and who believe math to be their most enjoyable or at least most 'comfortable' subject. So, those two seniors' actual math identity is informed by and "formulated as factual assertions" (p. 18), grounded in their accumulated successes in mathematics classrooms. On the other hand, their designated math identity as Sfard and Prusak (2005) remarked seemed to be "consisting of narratives presenting a state of affairs which, for one reason or another, is expected to be the case." In other words, designated identity refers to and is usually constituted by a larger narrative, and mainstream beliefs about what it means to possess a particular identity or to belong to a specific community. For instance, Kawhi believed that being a member of the math community means "to dive into it and be a part of it," and Weldon perceived it to mean going "to school to be a math teacher." It is important to point out that both students have the grades, proven ability and work ethics to 'dive into it' or become a math teacher if they so chose. However, one senior opted for accounting because it was "comfortable" and the other registered for a low level college math course because he was not training to become a math teacher. The two students felt the need to create in their perception of math education a distance between identifying and belonging. They expressed no "wish, commitment, obligation, or necessity" (Valeras, Martin, & Kane, 2012, p. 23; see Sfard &

Prusak, 2005) to establish themselves as members of the math community or to seek membership into the academic domain.

This was even more evident for lower performing seniors, with mostly negative experiences in secondary mathematics classrooms. For example, Kendrick distinguished between being a math person and being a member to the academic domain as early as elementary school. In fact, during our second interview, he said that in spite of all the successes he experienced in elementary and middle school math, he never considered a career in a math-focused field:

> Researcher: Was there ever a point when you saw yourself as a member of that community?
>
> Kendrick: No
>
> Researcher: Never? Not even in elementary school?
>
> Kendrick: Never, even elementary, I was doing pretty good but I know that I wasn't gonna choose nothing down that path.

It's important to note that a few times during the academic year Kendrick mentioned that he was thinking of becoming a firefighter. At the end of the interview he brought it up once more. He said that he was accepted into three colleges but was most likely planning on attending a local community college and major in Fire-Science and was nervous about the mathematics placement exam (field notes, June 2016). Similarly, Victor, another senior in this study whose overall experience in secondary mathematics classrooms was drastically different from his elementary and middle school years, drew a distinction between math people like himself who had no interest, felt no obligation enrolling in advanced college math courses and others who were

"willing to put in the time." He explained the reason he was a math person who was not compelled to put in the time below:

> Victor: I always wanted to do one thing in my life and that's to be a cop
>
> Researcher: Oh, I see
>
> Victor: So, it's like I wouldn't wanna go spend years of my time to go do math when I only wanna do this certain thing, this certain job. They probably decided they wanted to become accountants, make a lot of money…
>
> Researcher: Ok
>
> Victor: So, if I go to college to do advanced classes for math, it will be too hard for me and then when I do become a cop, I can't really do anything with the math.

Victor framed his disinterest in taking higher level college math as an economic decision where the frustrations he anticipated experiencing in a higher level math class would not match the modest salary and job requirements of a police officer. He explained the difference between identifying as a math person and belonging to the math community as matter of being "willing to put in the time."

Like Kendrick and Victor, Tyronne also struggled in high school math. He attributed most of his struggles to the two years he spent in an alternative public school for students with behavior problems which, he said, seriously compromised his chances of getting into a college. He confessed, during our second interview, that he was choosing to enlist in the navy because he was convinced that he would not be able to pass any of the college math placement exams necessary for admission. Indeed, in spite of the fact that he thought of himself as a math person

and that he was recommended by Ms. Turner to be in the honor's pre-calculus class, Tyronne was certain that college was an impossibility.

> one thing that really bugs me with most of this is that I keep telling myself that I can't go to school because it's like, you guys keep telling me that the stuff that we're doing now is like on entry exams everywhere and I'm just like then that means I can't come in because I don't, I don't get any of this (Personal Interview, Tyronne, 06/06/2016).

This interview took place about a month before the end of the academic year at which time Tyronne, like his classmates in the honor's precalculus class, already knew that he had fulfilled all his academic requirements for graduation. Nevertheless, as becoming a college student looked more and more like a reality, he and other students who struggled in the honor's pre calculus class started devising and implementing plans to avoid having "to do advanced math classes." For Tyronne, this meant choosing to enlist in the navy over filling out a college application. He identified as a math person but could not claim membership to the math community because he thought his math ability were inferior than his peers' and not strong enough to pass the college math placement exam.

It is somewhat peculiar that both high performing and struggling seniors established a distinction between the meaning of being a math person and the "wish, commitment, obligation, or necessity" (Valeras, Martin, & Kane, 2012, p. 23; see Sfard & Prusak, 2005) to be a member of the math community of learners and doers. This is a critical finding because it is consistent with scholars' beliefs that the construct of confidence in an academic domain along with students' perception of the domain is more complex and expansive than the mainstream notion

that 'success breeds confidence.' Darragh (year) argued that the conception of academic confidence as a sense of belongingness allows for more meaningful investigations of performance as "participation in a social ecology" (p. 216; see also Bolwer, William, & Brown, 2000; Esmonde, 2009; Lerman, 2009). In this paradigm, mathematics classrooms are *figured worlds*, "socially produced and culturally constituted activities" (Holland, Lachicotte, Skinner, & Cain, 1998, pp. 40-41) where students' academic identity are continuously constructed and constitute their relationship to a particular domain. Moreover, confidence as a sense of belongingness and "learning…as way of being in the world" (Wenger, 1998, p. 151) allows for the participants' stories about their math experiences, and identities to be analyzed in relationship to larger sociocultural realities and factors.

Racial hierarchy of math ability

A growing number of scholars have expressed concerns over the preponderance of studies in the field of mathematics education focused on the failure of black students (e.g. Johnson, 1984; Lubienski, 2002; Martin, 2007b, 2009a, 2009d, 2009e, 2012; Secada, 1992; Strutchens & Silver, 2000; Tate, 1997). Martin (2009) argued that this has contributed to the perception of a *racial hierarchy of mathematics ability* in America. A perception that pervades not only the literature in math education, but the math classroom and mainstream beliefs about membership to the academic domain. Borrowing from Foucault's (1966) *truth game* theory where "ideas and subjectivities come into existence and …limit what is possible" (Allan, 2011, pp. 276-277; see Foucault, 1984/1990b), this perception of who can be successful in mathematics and who cannot has colored teachers' attitudes toward black students' mathematical aptitude

(McGee & Martin, 2001; see also Martin, 2009). This was supported in this study by Ms. Turner's attempt to name students from her honor's math classes whom she believed to be math people:

> I would say, in class I would say…(she named three juniors of Vietnamese background). And I hear I'm picking my Asian students who people automatically think that it's because of that but I think it's more their personality. They're calm cause they don't always get it right away but they're patient, they would sit and they would listen, they just like calm themselves down. They're calm when they're learning. It's that personality (Personal Interview, Ms. Turner, 06/14/2016).

McGee and Martin observed that this perception of a racial hierarchy of math ability has not only created the truth game around who can be a math person (p. 49), but it seems to locate black students' perceived inaptitude in mathematics in the content of their personal selves, their racial, sociocultural identities.

This perception of who can and cannot do math has also informed students' beliefs about their mathematical abilities and identification with the domain (McGee & Martin, 2001; Martin, 2009). Another surprising finding in this study was that most of the seniors who participated did not perceive any of their classmates from the honor's pre-calculus class to be math people. This was true of the participants who identified as math people during the time of the interviews; it was also the case for most of the interviewees who conceded that they no longer or never saw themselves as math people.

In fact, Tamika, during her interview remarked that a few of the seniors were deluding themselves in thinking that their high grade point averages really meant something as far as college readiness or career preparation. And as far as math ability, she shared her views on why some participants, like Weldon, thought of themselves as math people.

> Researcher: Ok. Uh, do you know of any friends either here or outside of here that are math people?
>
> Tamika: (she signed heavily)
>
> Researcher: Would you call let's say Weldon a math person?
>
> Tamika: I'm not sure.
>
> Researcher: But do you think that he would consider himself a math person?
>
> Tamika: I think that he would consider himself a math person because it's like, he's not too strong in writing. Usually, people always think like oh you're not a math person, you have to be a writer. Uh, you know if you're not a writer, you have to be math. I think that he will consider himself one but I probably wouldn't.

Tamika, one of highest performing seniors in the honor's class, routinely complained about not having received the kind of education that would facilitate her transition into college and professional success. This continued even after she was accepted into a competitive university in western Pennsylvania. She believed that Weldon, along with other seniors, identified as math people as a response to their struggles in English classes, and as a way to justify the contrast in their performances. Tamika dismissed her classmates' academic achievements once again during

a discussion about Weldon being the school's valedictorian. This took place near the end of the academic year. We were in Ms. Turner's classroom, during her lunch period where she was engaged in a lively conversation with a handful of seniors. In the mist of seniors planning and fantasizing about what they hoped for their fast approaching prom night,

> I found out that Weldon was the valedictorian. However, Tamika didn't believe being valedictorian at Oxford meant much. In fact, she said that "people are quick to brag about grades" that they didn't really get on their own. She said that without Ms. Turner's help and other teachers' help, she wouldn't have the grade point average that she had now. She warned students…to not be fooled by their grades because they're inflated and that it's the end result of Ms. Turner helping them during tests. Tamika wanted seniors to realize that Ms. Turner wasn't going to be there in college to help them during exams and that they were going to be in for a rough awakening (field notes, Thur 05/26/16).

Ms. Turner was taken aback by Tamika's candor and refuted her statement by saying that Weldon worked hard and was a very gifted student and deserved all of his achievements. It is important to remember, as it was stated earlier, that Tamika and the other seniors who participated in this study had not only experienced years of academic success but represent the "10 percent of American children [to] complete the sequence of high school mathematics—algebra, geometry, trigonometry, and pre-calculus—that are required in many other countries" (McGee & Martin, p. 48; see Schmidt, 2003).

Tamika's sentiments were echoed by Shalik who, as discussed previously, no longer thought of himself as a math person in spite of his successes and high level of engagement in the honor's pre-calculus class. During our first interview, he remarked that it was difficult for him to name any math people among his classmates because it appeared that everyone was on the same level:

> Researcher: Why do you think that is because you're in an Honor's [math] class?
>
> Shalik: It might be my area that I live in
>
> Researcher: But you're an honor's class, you don't think you should be like 'there are bunch of math geniuses in [my] class'?
>
> Shalik: Yeah, I do but it's not. I kinda feel like, but you know that this school is not like special admission so, uh, I feel like they wanna have the honor's class so they have to use the kids that they can and I think, don't they go off of your grades…

Shalik added another component to Tamika's assertion about students inflated grades and sense of confidence. He underlined the fact that Oxford was a neighborhood urban public school serving students from nearby low-income communities. Indeed, the school is located in an under-resourced northeast region of Philadelphia. The median income of the Oxford neighborhood is below the city average and roughly 32% of its residents are living below the poverty level (City-Data.com, retrieved from http://www.city-data.com/neighborhood-Philadelphia-PA.html). Shalik pointed to his fellow classmates' social backgrounds and the fact that they were admitted into Oxford without "special admission" as the reasons why they were not math people. He conceded, later in the interview, that the honor's pre-calculus class was

exceedingly challenging compared to the "regular math classes" at Oxford which he characterized as "very, very easy." And in spite of his and other students' good grades and high performance in the class, he was convinced that the seniors in the class were "unsure when it comes to math."

Moreover, when Shalik was prompted to explain whether he thought there was a particular race associated with a math person he replied "Caucasian." He explained the roots of this perception below:

> Well because I like to watch the Guinness World Records and stuff and the person holding the Guinness World Record for solving the longest math problem is Caucasian. So, yeah and just being around Caucasian kids, I know that they excel in math a lot. I'm not around many African Americans who do. So, it's just that (Personal Interview, Shalik, 02/05/2016).

Shalik claimed that his belief that whites were better in math than blacks originated from subliminal messages conveyed to him through mainstream television programs like the Guinness World Records and his experiences in racially and socially segregated urban schools like Oxford. These beliefs were shared by other seniors interviewed for this study. For instance, Kendrick, a Jamaican native and a north Philadelphia resident for about three years, said that he was introduced to the notion that whites and Asians are better in math than blacks while watching television:

> Kendrick: I think that since I came to America like about two years there, I was watching something, they were saying Asians and whites are smarter in

> math and, I never heard like African American, they never talk about African Americans, they were talking like they were better than blacks at math but I don't think that's true.
>
> Researcher: Was that a movie that you were watching?
>
> Kendrick: I think it was some TV show or something and I saw it again on Family Guy too. Asians are always smarter than math. They were saying like Asians are really smart, if you're Asian, you're smart in math…

It's important to note that Shalik, Tamika and Kendrick were slightly puzzled, uncomfortable, and even a bit embarrassed by this admission. In fact, Kendrick punctuated the recounting of his introduction to the belief that Asians were superior in math with "but I don't think, I don't think that's true." Likewise, Tamika was shamed by the fact that her image of a math person was that of someone white or Asian. She confessed that her views of what a math person looks like were probably imposed on her by mainstream beliefs that pervade her community and society at large.

> It's just how society kinda is. It's like 'oh this person is white, so they know it.' Or this person Asian, Chinese or from China, they know it. You know what I mean. And I know certain places take education more seriously but I don't know. And it's just out there so much, that's what we think because it's just out there so much. Even some times like our parents would say it, like 'oh well they're Chinese, they're probably on top of their class' you know. So, it's kinda installed in us which it really shouldn't be cause that can be like stereotyping.

Tamika ended her admission with the acknowledgment that she was "stereotyping" and that she wished that it were different. She hoped that there wasn't much credence to this belief that she

shared with her fellow classmates and family members. Particularly as it relates to her college and overall future prospects. As stated previously, Tamika never felt secure in her academic abilities or even successes. She was convinced that she wasn't ready for college and would likely struggle keeping up with the academic requirements and anticipated rigor. This dark cloud loomed over many of the seniors in the honor's pre-calculus class. On several occasions during my visits, seniors would inquire about how 'hard' college really was and what they should be expecting. Often seniors would extrapolate their struggles with a particular mathematical concept (like complex numbers) to what being in a college classroom will be like (field notes, September 2015—June 2016). These sentiments were intensified in the weeks and month before graduation. Stephanie, who also believed that Asians and whites were better in math, shared similar concerns at the end of our second interview which took place at the end of May, a few school days before prom night:

> Stephanie: At this point what's running through my mind is I'm ready to get out of high school. I'm ready to graduate, you know I always say that, I'm ready to graduate and stuff like that. I'm just trying to see what the future holds. I'm actually thinking 'oh god what do you wanna do.' I know what I'm gonna do but like first trying to make sure that I don't be like one of those typical kids that drop out of college. They put so much work to get there and then they're like 'oh, I can't do this.' Or they don't wanna work. Again that goes with the simple issue of the whole stereotype. You do all this work to just drop out being that I'm African American that just graduate from high school
>
> Researcher: Is that one of your biggest fears?

Stephanie: Yes

Researcher: Yeah? Not graduating college?

Stephanie: Yeah.

Andre, a low performing and high confidence math student, and Kendrick were the only two seniors out of the students interviewed who were able to name classmates they conceived of math people. In fact, Andre believed that everyone in the honor's pre-calculus class was a math person because it wasn't a required course and that the seniors in the class elected to be there. He explained this during his first interview:

Andre: The classroom that we're in now, I guess everyone cause it's an optional course.

Researcher: Yeah, but would you say that everybody in this class is as passionate as you?

Andre: As passionate as me?

Researcher: Yeah, enjoys doing it

Andre: I feel as though it's my goal, so I'm put myself ahead of everybody. Nobody's on the same level as, I'm not saying that I'm the smartest kid in the class but I'm saying…

However, Andre drew a distinction between himself, a math person "passionate" about mathematics, and the rest of the seniors in the class. In fact, Andre, like Kawhi, the only other senior interviewed for this study interested in a math oriented career, contemplated majoring in accounting. He defined a math person as someone who has "some passion for it." And when I pressed him to use his definition and identify classmates from the honor's pre-calculus class who

were passionate about math, he replied "I don't know. I don't really talk to anyone." Unlike Andre, Kendrick listed names of students whom he identified as math people:

> Researcher: How many people would you say in this class, in Ms. Turner's class are math people?
>
> Kendrick: Uhm (thinking)
>
> Researcher: Or anyone you know for sure that this person is a math person?
>
> Kendrick: …Tamika or Weldon, you can see that they know their stuff. Who else? I don't know. Those two.

Kendrick has been with most of the seniors in the honor's pre-calculus class for at least two years. Most of the seniors in Ms. Turner's class were part of her junior honor's algebra II class the previous year. Moreover, because most the same students are also enrolled in honor's English, many of the seniors in the class have been together for several of their four years at Oxford. Kendrick identifying Tamika and Weldon as math people likely stemmed from the many academic experiences he has shared with them, the countless times he has witnessed them on the board solving problems, or at their desks answering and asking thoughtful questions. He alluded to this in his response, "you can see that they know their stuff." Thus, it was puzzling when Kendrick singled out a junior whom he didn't know from Ms. Turner's earlier honor's algebra II class and exclaimed "He is good, right?." He wanted me to confirm his belief that the junior in question was a math person. I asked him about this during our first interview:

> Researcher: Do you remember that there was a time you were coming in class, I was there, and there were some juniors finishing up their quiz, and there was a kid sitting

there, I guess who looks asian, and you pointed to him and say that you knew he was a math person.

Kendrick: Yeah, I remember that.

Researcher: You remember that? Why did you say that?

Kendrick: Yeah, cause they always say that most asians are good at math. So, they always say like asians are smarter in math and stuff like that. So that's (interrupted)

Researcher: Do you believe that?

Kendrick: I believe it.

Both Andre and Kendrick had no trouble identifying seniors whom they thought were math people. In both cases, their responses were grounded in evidence and sensible explanations for why they identified specific seniors as math people. Andre believed that choosing the rigor of an honor's pre-calculus class is proof that every senior was a math person. However, he wasn't convinced that his classmates shared the passion he believed a math person has for learning and doing mathematics. He didn't believe that electing to be in an honor's pre-calculus class was evidence of passion in math. Andre said that he couldn't answer whether his classmates were passionate about math because he didn't know any of them well enough. It's worth reiterating that Andre was among the seniors who were the in the honor's algebra II class as juniors the previous year. As far as Kendrick, he could only identify two math people out of at least a dozen seniors with whom he had taken a previous honor's math class. However, without explanation or evidence, without even being prompted, he felt compelled to share his belief that someone who looks Asian is likely a math person:

> Kendrick, a tall [black] student born in Jamaica and who entered the U.S. as teenager, and whose desk happened to be directly behind the junior who was still working on the quiz, said, "He is good, right?" (Field notes, Wed 03/02/16).

Nigel, who identified as a math person, and who was made aware of racial stereotypes and the need to prove them wrong by his mother, admitted during our interview that he experienced instances where he had to show teachers that he was as competent in math as his Asian classmates. This was particularly evident during his years in elementary school where he was often in classes "with a lot of Asians and white people. And they, they just always figure that they was always the best but I was always running like in the competition." Nigel, in spite of his and other black students' successes in elementary math, said that he also thought his white and Asian classmates to be academically superior. He explained this further during our interview:

> Cause people knew they was. Even though I do well, they gotta see it for their selves. People know they're gonna do well. It's like say it's two tests right there, they look at them like, 'oh I knew you got that.' But oh [referring to himself] do you got that?

For students like Nigel, not only that they feel the need to prove to themselves that they can compete academically with their white and Asian counterparts, they must also at times prove it to others. During the same interview, Nigel recounted an instance during his junior year at Oxford when a teacher, looking at his report card, had trouble believing that the high marks on there were in fact his grades:

> Nigel: It's really what I wanna know though. Why, why people think I'm not like a school person. Alright, look another instance. Last year, when I got my report card, I got straight

A's. So, I'm walking down the hallway, a teacher said let me see your report card, you probably got D's and C's.

Researcher: Is that a teacher you had before?

Nigel: No

Researcher: He doesn't even know you

Nigel: Don't know me. He took my report card, "straight A's? You lying." I'm like it's right there. Like, dude really couldn't believe I had straight A's.

Researcher: Does that bother you?

Nigel: Yeah, it bother me. I don't even know why.

The pattern, found in this study, of high achieving black students in an honor's pre-calculus class struggling to see themselves and their classmates as belonging to a math community of learners and doers is evidence of Valeras, Martin and Kane's (2013) conceptualization of learning as *racialized forms of experiences* (p. 324; see also Martin, 2006, 2007, 2009; Martin & McGee, 2009; McGee, 2009; Stinson, 2008). Martin (2006) defined "racialized forms of experiences" as "experiences where race and the meanings constructed around race become highly salient" (p. 198).

In a classroom, this means that participation in an academic domain and students' relationship to that domain involves "developing competencies related to the discipline *and* 'a way of being in the world' relative to the discipline" (Valeras, Martin, & Kane, 2013, p. 324; see Wenger, 1998). As it pertains to mathematics, there is a disproportionate number of studies focused on the failures or low performance of black students compared to their successes and

achievements in the discipline. The abundance of data and analyses on black students' poor performance in mathematics has reverberated throughout academia, mathematics classrooms and society at large (Martin, 2006, 2007, 2009). It has created "common-sense beliefs and official knowledge about who is competent (and not) in mathematics" (McGee & Martin, 2011, p. 49). This was evidenced in Tamika's insistence in questioning and at times delegitimizing the value of her high performance in honor's pre-calculus or any other senior's academic achievements. Similarly, it shaped Shalik's perception of an honor's class composed of mostly black students as Oxford "us[ing] the kids that they can" because of the "area." Meanwhile, both students were convinced, without explanation or proof required, that whites and Asians were mathematically superior than blacks. Some scholars have referred to this phenomenon as a *racial hierarchy of mathematics ability* that is "widely accepted" and has remained "largely uncontested" in the field of education (McGee & Martin, 2011, p. 49; see also Martin, 2007, 2009). Subsequently, high performing black students interviewed for this study struggled trying to reconcile their academic achievements and mostly positive experiences in mathematics classrooms with their perception of the discipline and understanding of what it means to belong to the math community. They were "not as much engaged in self-making, but rather [were] limited" given the "identities being offered to them" in Ms. Turner's honor's pre-calculus, at Oxford, and in mathematics education. (Urrieta, 2007, p. 111; see also, Ibrahim, 1999).

Racial Identity Construction

It is also important to highlight the fact that all the participants said that they were aware of the negative stereotypes surrounding African Americans, like for instance being stereotyped

as academically inferior in disciplines like mathematics. However, they also explained that being black, to them, meant being better than average and proving the stereotypes wrong. Furthermore, many of them saw no relationship between being stereotyped as mathematical failures and not seeing themselves as members to the community of math people.

Seniors who participated in this study had all been, although at often very different stages in their lives, introduced to the negative images associated to being black in America. Kawhi recounted his first experience having to think about the meaning of his skin color, how it can be perceived and the kind of treatment that may ensue from this perception:

> I think the first time I ever really, really understood the difference was when I was, we had the whole scholastic fair] in my middle school and it was like the day after or maybe the day, it was towards when it was ending and I went in there just to see the last few books but I didn't really want anything. It was in the library; so I happened to just go over it, I don't know why, I'm pretty sure I wasn't skipping a class, so, I'm guessing—I didn't do that—so, I'm guessing it was just library time, I don't know what it was, but I sat down and I saw an Emmett Till book and that was, that was the first time I saw something that was like, like he was treated this way solely because he's black. Like that was the first time I think I ever actually saw it and I was like he didn't really do anything. Like he was young, he was not gonna harm her, uh he was you know doing…

This was a major turning point in his identity construction as a middle school-aged black boy growing up in Baltimore. The tragic and unjustified killing of Emmett Till made him aware of not only his skin color but its salience in relationship to the world around him. Kahwi, suddenly,

became conscious of the fact that being black may in some instances and under certain circumstances elicit reactions that don't seem to warrant explanations or justifications. Similarly, but less dramatically, Stephanie came to the realization that she was African American in elementary school during black history month:

> I became aware that I was African American probably about during the time period in elementary school you know you always have Black History month and it was like, I was just like, I had to have been the like, like elementary school, like the 5th grade. Between that time, 3 through 5, I was being aware that you are African American. I don't know what other race I might have thought I was but I, when I was two you know African Americans and became more aware of the slavery and things like that. That's when I came to my mom and said "mom, what am I?." You know cause it's a question every kid ask.
>
> Researcher: What did she say?
>
> Stephanie: You are African American. Yeah, you have kids that have multiple other races such as I do but, the first thing that came out of her mouth was "You're African American."

In both cases, Kawhi and Stephanie came to identify as being black within the context of the history of violence and injustices perpetrated against African Americans in this country. Whether it be slavery or the decades of legal racial segregation that followed, their racial identity began as a revelation, and a consciousness that being black connotes identification with being victimized.

For Tyronne, the realization that being black meant more than just pigmentation materialized itself in elementary school while learning and doing mathematics:

> I don't know, I guess it was like all the praise that my teachers were giving me for doing what it was that I was supposed to do. It's like I'm never, I'd never seen that. So, I was just, it kinda threw me off, it's just like why ya'll acting like this and like when I think back on it now, it's like 'oh, we got this little black kid and he's doing his math.' And it's just like (laughter), because I had good grasp on my math because my dad punished me with education. Like when I got in trouble in school, I would have to take a "Marble Notebook," a marble notebook, like one of these (holding a notebook), and start from like my two times table up to my twelve and fill the book.

Unlike Kawhi and Stephanie, he was introduced to being black through being perceived and treated as exceptional, an example kid by his teachers for answering math questions that he had practiced at home. The "praise" for "doing what [he] was supposed to do" constituted another instance of being black, in a mathematics classroom, eliciting unwarranted reactions.

Those students' stories represent examples of the conception of identity as an experience, and "a way of being in the world" (Wenger, 1998, p. 151). A world in which black boys and girls entering into adolescence and adulthood are more likely than dominant, majority groups to develop racial/ethnic identities shaped and informed by "their distinctiveness in their environments" (Chatman et al., 2005, p. 118; see also Crocker et al., 1994; McGuire et al., 1978; Phinney, 1992).

The attributes that make up the individual's identity render their need to belong to a specific group and to be distinct from the rest of the world (including that group) more salient (Beaumeister & Leary, 1995; Brewer, 1991; Eccles & Barber, 1999; Eccles et al., 2003; Erikson, 1968; Youniss & Yates, 1997). This tends to manifest itself more during adolescence where the individual feels compelled to affirm his uniqueness while also embracing a collective identity. In the case of racial/ethnic minorities like the seniors selected for this study, Chatman et al. (2005) argued that individuals are confronted with the "additional developmental task of considering race and ethnicity in their identity formation" (pp. 120-121). Because of their perceived differences from the majority dominant racial group, individuals from racial and ethnic backgrounds often share feelings of "marginalization" and the need to appropriate protective mechanisms "to cope with the dominant culture's [anticipated] disparaging views of their group" (Coard, Wallace, Stevenson, & Brotman, 2004).

All the participants interviewed were conscious of the historical significance of being an African American and responded to that history with unbending determination to be "strong" and "show the world otherwise" (Stephanie, 2nd interview, May 2016). Kawhi described his perception of the meaning and responsibility of being black as having to continuously be better than average:

> Everything I do has to be better than normal. That's one of the biggest things. I think as far as culturally, as far as socially, a lot of things that a black person does are going to be copied and researched. A lot of things that we do are going to be sold as less until it's in the mouth or I guess the abilities of a white person. I've come to realize that…the

> darker the person, the better they have to be.

He explained that because his actions and performance are evaluated against his white counterparts that he always felt the need to be "better." Kawhi believed that the standards used to rate him are not value-free; they seem to skew in favor of an ideal inspired by and modeled after what it means to be white. Similarly, Stephanie viewed being black in this society as a fight to change the mainstream mostly negative image and narratives associated with African Americans in this country. She delineated her understanding and perceived responsibility of identifying as a black American:

> Being African American to me means being strong. I don't know how to word it or what's the word you can use for it, but to sum it up, you have to show the world otherwise. Cause again as you see that's not, there's multiple stereotypes but it seems as though we always get stuck with the negative ones. For some odd reason, that's just how the world works, we always get stuck with the negative ones. So, we have to work twice as hard as any other race to show that we are the opposite of what they may see on TV, or what they may see on videos.

Stephanie, like Kawhi, feels an individual and social responsibility as honor's black students to not only be successful but challenge the disparaging image of black Americans that pervade many aspects of the world surrounding them. Kendrick, the only senior in this study who's not an American citizen, echoed the other participants' perception and sense of duty about being black in this country. He went even further and explained that being strong and being better than average was necessary in order to prove to the world that blacks are "normal." Kendrick, who's

been in the U.S. for three years during the time of this study, ended his second interview detailing what he understood being black in America to mean:

> I would say like we are a minority. We gonna notice that, you gonna be aware of that but you still have a lot of good black people, we're normal just like everybody else. And we can't, we can't be, if I'm gonna explain it to somebody, I will say like we're normal. We're a minority but we're normal, we're here, we're doing the same thing, we can achieve the same thing everybody's achieving so, we just a minority but we're the same like everybody else.

Kawhi, Stephanie and Kendrick saw being black as acknowledging and needing to confront this country's history of oppression, unequal treatment and negative image of African Americans. They developed a seemingly insatiable desire and duty to succeed as a way to protect themselves from and "to cope with the dominant culture's [anticipated] disparaging views of their group" (Coard, Wallace, Stevenson, & Brotman, 2004).

Even seniors who were uncomfortable or unable to express their views on what it means to be black suggested in their responses the need to prove that they were normal. Nigel, who told me that he was raised by a mother who made him acutely aware of the negative stereotypes associated with being African American and who taught him to "go beyond and just show them that like [he] could do it too," resented having to talk about race. During our first interview, he expressed feeling uncomfortable "playing the race card" after recounting two instances where a

teacher and a school counselor questioned the fact he was a high achieving student (Nigel, Personal interview, 02/08/2016):

Researcher: So, you think people are doing that because of your skin color?

Nigel: I don't know. No, cause there's a lot of black people in the school.

Researcher: If you were a white kid, do you think that people would ask to see your report card the same way?

Nigel: No, I don't. But I don't like pulling the race card. Why you pulling the race card?

This resurfaced during our second interview where Nigel resisted and pushed back against having to answer what it means to him to be black:

Nigel: What type of question is that? What does it mean to be black?

Researcher: To you

Nigel: I'm black. African-American

Researcher: What does that mean to you?

Nigel: I'm black. It's like…

Researcher: Like what is the first thing that comes to your mind when you say I'm black? What else does that mean to you?

Nigel: That's my race. Like I'm black, ain't nothing more to it. I'm not different. How I'm different cause I'm black? I'm not different, I'm just black. That's my race.

However, it's important to underscore that Nigel in his frustration with my question expressed the need to explain that black is simply his "race" and that there "ain't nothing more to it." He

stressed the fact that he was "not different" because he was African American. Like Kendrick, Nigel's identification with being black connotes the responsibility to explain and prove to others that he was normal. Likewise, Weldon also had difficulty explaining his view of what it means to be black. He began by underlining the fact that he was a mixed-race person who identifies as black:

> I'm white and black but I was always brought up that you're whatever your father is and my father is black. So that's what I label myself as…
>
> Researcher: What does it mean to be black to you?
>
> Weldon: What does it mean to be black? Oh, I don't know
>
> Researcher: How would you answer that?
>
> Weldon: I don't know what does it mean to be black

However, a moment later, he echoed the other participants' view on the meaning of being African American by explaining that identifying as black should be a motivation and an opportunity to change the world's derogatory view of black people:

> Cause I don't let it stop me. That's the thing. It's like some people let it stop them and be like 'oh I'm not going to this like all white school.' It's like you can't let it stop you. You have to be you and you have to make a difference. You can't let it and then you you do it, you'll be known for it too.

This is the process that many scholars have identified as *racial socialization* (e.g. Boykins & Toms, 1985; Hughes & Chen, 1997, 1999; Ogbu, 1981; Rotheram & Phinney, 1987; Stevenson, 1994a, 1994b; Tatum, 1987, 1997). Rotheram and Phinney (1987) described racial

socialization as the "development processes by which children acquire the behaviors, perceptions, values, and attitudes of an ethnic [or racial] group, and come to see themselves and others as members of the group" (p. 17). This signifies that the seniors who participated in this study have developed specific belief systems and worldviews that not only constitute their individual and collective identity content, but also serve to aid them navigate and negotiate their position in society. For them being black means "protection against racism, pride and heritage about…the black experience, and the need to succeed within mainstream [white] America" (Strauss & Cross, 2005, p. 68).

Impact of stereotype threat

Pertaining to mathematics, the students all rejected the notion that their racial identity had any negative influence on their math identity construction. In fact, most of the seniors, whether they identified as math people, used to or never did, perceived of membership to the academic domain as independent of identifying as a racial group stereotyped as low performing.

They all acknowledged being conscious of mainstream beliefs of a racial hierarchy in mathematics ability but believed that math classrooms represent opportunities to "show yourself more" to the world (Stephanie, Personal interview, 06/07/2016). Stephanie elucidated this point during her second interview:

> I feel as though any stereotype doesn't do anything to me. It takes you as the individual to change the perception if that's what you like to do, if it's your favorite subject. In this case, honestly I wouldn't care if someone came up to me and said 'you know black people don't like math.' I would be making an objection to it but it wouldn't be arguing for

> myself, it would be arguing for the other people that are math people, that like math. Again, I'm one of those people that like money but can't stand math. It's the truth.

She also believed that identifying and seeing yourself as a member of the math community is more of a personal and individual choice. This is in spite of acknowledging that she was aware of the fact that black students are stereotyped as low ability and that math represents a chance for African Americans to "change the perception." As stated earlier, Stephanie doesn't believe that she ever was a math person and in fact characterized mathematics as something you have to get through in order to realize your academic and professional dreams (Stephanie, first interview, March 2016). However, she also expressed frustrations of always having to be better than average and show the world otherwise:

> Sometimes it stresses me because that means I try to put more pressure on myself. Especially when you're around different minorities and sometimes different minorities come off as though they know more than you because of the fact, they may not say it, but their demeanor, the way they come off is as though 'I know more than you do.' And, I'm not saying that every race is like that but you can tell someone's demeanor, the way they act is as though they know more than you. And the first thing you think of is because of race because why would you look at a male or a female and come off as though you know more than them, their race. So, honestly I put more stress on myself because I feel like you have to put twice as more effort in showing them that I know as much as you know if not more. You're putting more pressure on yourself which is not a bad thing because at the end, you always come out with a good outcome

Nigel expressed similar views pertaining to the impact of being stereotyped as low ability may have on his membership to the community of math learners. He refuted the notion and believed that "You just gotta do it if you wanna be part of it" (Nigel, second interview, May 2016). He identified as a math person because of his positive experiences in mathematics classrooms in elementary and middle school and also because math was always his favorite subject. Moreover, he explained during our second interview how he was socialized by his mom to view the classroom as a place to reject negative stereotypes about being black:

> Nigel: my mom is heavy in this stuff cause she talked to me about it a lot
>
> Researcher: Heavy in what stuff?
>
> Nigel: that racial type stuff. She always try to say rise above it. Don't, let them put you in that stereotype cause it's not true. So, my mom always talks to me about that. That's why I took school seriously.

Nevertheless, Nigel, a month or so before graduating, viewed pursuing a math oriented career as too much of a "hassle." As other seniors who distinguished between being math people and membership to the academic domain, he made a distinction between identifying as a math person based on his K to 12 successes and committing as a college student to be a member of the math community. Also, he characterized going into a math focused career as a personal choice and not a social responsibility to "rise above" a "stereotype cause it's not true." College mathematics classrooms symbolized something completely different for Nigel:

> Researcher: So, being a math person, does this mean that you're going to look for majors in college that will require you to take advanced math courses?

Nigel: No. Not really

Researcher: (laughter) Looks like you wanna say more

Nigel: Yeah but, I just don't like going through the hassle

Researcher: What do you mean?

Nigel: If it's like, a hassle cause I'mma be playing football and all that. So, if I feel like it's making me stressed out, I'm not gonna do it.

And concerning the lack of effort and interest he exhibited in the honor's pre-calculus class, Nigel explained that he was tired and that senior year was time to finally "rest because of all the stuff [he's] been pressured over like all these years, all these extra stuff."

Nigel and Stephanie conceptualized academic performance as an opportunity to prove negative stereotypes wrong. However, both viewed membership to the math community of learners and doers as an individual choice that is independent from race or irrelevant to being stereotyped as not belonging to the community. Moreover, the two seniors, who have experienced considerable academic successes, expressed frustration from always having to put in "twice as more effort in showing them" and "rise above" the stereotypes. This is an aspect of what scholars have referred to as *stereotype threat* (e.g. Steele, 1997; Steele et al., 2002). Steele (1997) defined the concept of stereotype threat as the "aversion" or negative thoughts harbored by "members of any group about whom a negative stereotype exists;" these thoughts can shape stereotyped individuals' perceptions of specific social contexts and experiences (p. 614). For instance, Tamika viewed success in an advanced math class as meaningless and more of a result of Ms. Turner helping students during in class assessments than an indication of her college

readiness. Or, that Shalik, along with many other seniors, were unable to perceive of their classmates in honor's pre-calculus as math people but more of Oxford 'using the kids that they can.'

Stereotype threat is "situational" in that it is continuously being shaped, affirmed and challenged by every situation (Steele, 1997). Spencer, Steele and Quinn (1997) found that women and African American students, stereotyped as low-performing in mathematics, experienced significant level of emotional distress and pressure when taking standardized mathematics tests. Moreover, Steele (1997) observed that stereotype threat experienced in a particular domain over a continuous length of time can pressure stereotyped individuals into *disidentification*; that is to dis-identify with or dissociate from a "domain" as a self-identification and self-actualization process (pp. 614-615). For students like Stephanie and Tamika, who were among the highest performing seniors of the pre-calculus class, and who never identified as math people, they felt compelled to dis-identify with mathematics because being better than average in the domain didn't appear to be sustainable.

Steele (1997) remarked that the process of disidentification can have negative effects even on stereotyped individuals like Nigel, Weldon and Kawhi who possess the "skills and self-confidence to have identified with the domain" (p. 615). The problem, he argued, is that individuals from social or racial groups characterized as low-ability in a particular domain and who "remained identified with [the] domain" will experience sustained threats and obstacles to their continued "identification with the domain" (pp. 615-617). For instance, Nigel's feeling that

he always had to prove, whether in elementary or high school, that he was a high performing math student, or a math person constituted sustained threats to his identification with the domain. So, having to continue this as a college student, with more abstract and demanding mathematical contents, seemed to him too much of a hassle. Kawhi and Weldon, in spite of testing into advanced college math classes and obtaining the highest grades in honor's pre-calculus, dissociated themselves from the community of math learners and doers because they perceived membership to represent a level of commitment, obligation, and necessity that they weren't interested in or believed was part of their academic identities (Valeras, Martin, & Kane, 2012, p. 23; see Sfard & Prusak, 2005).

Summary of the findings

This was an examination of the math confidence of a mixed ability group of seniors enrolled in honor's pre-calculus at Oxford high school. The main patterns that emerged out of a multilevel analysis of this study's field notes, interview transcripts, students' graded work and other data sources were divided in three categories: "Impact of Accumulated Math Experiences," "What does it mean to be a *Math Person,*" and "Math Confidence."

The first section focused on students' experiences in mathematics classrooms. Most participants summarized their overall experience positively. The majority of the students identified as math people between elementary and middle school. However, only 7 out of 11 participants still believed that they were math people during the time of this study. The others

either ceased to think of themselves as math people or never identified with the academic domain.

Nevertheless, in the following section "What does it mean to be a math person," all 11 participants defined a math person as someone born with a natural aptitude for numbers or for knowing and applying the institutionalized ways of doing mathematics. The interesting patterns that emerged out of students' consensus of what it means to be a math person is the variability in their identification with mathematics. Some students no longer felt confident in their ability to know and apply the right procedure to solve every type of pre-calculus problem. Because of this, high performing students like Shalik, Tamika and Stephanie, could no longer conceive of themselves as math people. However, Tyronne, Felix and Andre who struggled and showed minimal interest in pre-calculus still identified as math people during the time of this study. This section challenged the mainstream belief that success or competence in an academic domain informs students' confidence. It also illustrates Hardy's (2007) assertion that confidence elicits "reference to social practices" and an examination of the "relationship between individual subjects and [their social realities] (p. 23).

In light of this, it is critical to note that the only two girls who participated in this study, Tamika and Stephanie, were the only students who characterized their overall experience in mathematics education as a struggle. They said that they never identified as math people. In fact, they both dismissed their success and high level of engagement in honor's pre-calculus compared to the majority of the students as meaningless. Meanwhile, some of the male participants, who struggled or showed very little interest in math during their senior year,

reconciled being a math person and not putting adequate effort into a math class as the result of senioritis or some institutional failure. Although this study's sample size and gender composition is not representative of Oxford's student body, further research focused on the intersection of race and gender in the field of mathematics education is needed in order to provide meaningful insights into Tamika and Stephanie's interpretation of their success in math as 'something you have to get through.'

The final section was concerned with students' math confidence as defined by some scholars a sense of belonging (Darragh, 2013; Hardy, 2007). Data measuring students' confidence levels using a Likert scale survey compared to participants' ratings of their math confidence during their interviews showed that the construct confidence is not fixed; in fact, it refers to "socially produced and culturally constituted activities" (Holland, Lachicotte, Skinner, & Cain, 1998, pp. 40-41) that continue to shape students' math identities and serve to inform their sense of belongingness. One of the interesting patterns in this section is that high performing students who still identified as math people like Kawhi and Weldon felt the need to draw a distinction between being a math person and belonging to the math community. Both students conceived of membership to the academic domain as something more than identification; they thought of it as "constantly…looking for new ways to develop in mathematics" or being a "math teacher." Similarly, struggling students like Victor and Tyronne who still viewed themselves as math people, were not only convinced that they weren't members of the math community, they were certain that college math would be an unnecessary hassle or

an insurmountable obstacle. This is an illustration of what Sfard and Prusak (2005) labeled as *actual identity*, "consisting of stories about the actual state of affairs," and *designated identity* which refers to and is usually constituted by a larger narrative, and mainstream beliefs about what it means to possess a particular identity or to belong to a specific community (p. 18).

Every participant conceded that the larger narrative of what it means to be a member of the math community means to be Caucasian or Asian. In fact, 9 out of the 11 participants were unable to identify any of their classmates in the honor's pre-calculus class as a math person. Some students like Shalik and Tamika believed that being an honor's student at Oxford was simply the school using "the kids they have" and bore no other significance as far as college readiness or professional prospects. Even Andre and Kendrick who were able to name classmates as math people did so with a caveat. Kendrick identified Tamika and Weldon as math people because he was convinced that they 'knew their stuff' after observing them in the classroom for four years. However, he did not need any evidence to believe that a junior of Vietnamese background whom he did not know was 'good' in math. Similarly, Andre believed that every student in the honor's class was a math person because honor's pre-calculus is an elective. However, he was not convinced that they had the 'passion' he believed was required to be a math person.

Every student selected for this study identified as black and saw their racial identity as a social responsibility to disprove mainstream disparaging views about African Americans. Some participants, like Nigel, Stephanie and Kawhi, said that their history of academic successes was

partly motivated by their perceived duty to prove the stereotypes wrong. They were also acutely aware of the negative stereotypes surrounding mathematics education. Some students like Tamika, Stephanie and Kendrick alluded to subliminal and overt messages from their communities and mainstream media of a racial hierarchy in math ability. However, none of the students believed that there was a relationship between identifying with a group stereotyped as failures in the field of math education and not conceiving of themselves as members of the math community. In fact, some students, like Stephanie, viewed pursing a math-oriented career or enrolling in more advanced math classes as a personal choice; she did not view seeking membership to the math community as a social responsibility.

Addressing the Core Research Questions

This study addresses a gap in the literature on mathematics education by focusing on high achieving black students' perception and identification with math. Moreover, it challenged the narrative of black students as mathematical failures that pervades the extant scholarship, the classroom and mainstream beliefs about African Americans (e.g. Anderson, 2009; Hale, 2001; Hernstein & Murray, 1994; Ladson-Billings, 2006; Martin, 2009a, 2009b, 2009c, 2009d, 2012; McGee, 2009; McLoyd, 1991). Finally, this study made use of a nuanced and expansive conception of academic confidence as a sense of belonging (Burton, 2004; Hardy, 2007) to examine honor's students' interpretation of their history of success in mathematics classrooms and being stereotyped as low ability in the field of mathematics education.

How does black students' accumulated experience in mathematics education shape their perception of and identification with mathematics?

All the participants in this study had considerable success in mathematics classrooms. Most of of them interpreted their elementary and middle school experiences as evidence that they were math people or that they were born with a natural aptitude for numbers. They viewed a math person as an exceptional thinker with an extensive knowledge of mathematical rules and an understanding for how to apply those rules. However, as high-school seniors enrolled in honor's pre-calculus, their identification with mathematics was more complex and layered.

Seven of the participants still identified as math people during the course of this study; however, their experiences in secondary education seemed to have convinced most of them that college majors requiring advanced math courses is unfeasible or too much of a hassle. This was true of Weldon, Oxford's valedictorian who registered for a lower level college math course after being placed in Calculus I. It was also true of Victor who struggled his entire senior year and was certain that advanced math was for "astronauts." Similarly, Felix and Nigel expressed concerns about the amount of effort college level math would likely require of them. Tyronne chose not to apply to any colleges because of his fear of the math placement exam. The five participants mentioned above still identified as math people during the course of this study. Their positive identification with mathematics cultivated throughout elementary and middle-school appeared to have survived secondary education. However, some students, like Tyronne, protected their math identities throughout high school and in honor's pre-calculus, by redefining academic success as a "game" that being "caught up in things outside of school" did not allow them to "play" (Personal Interview, Tyronne, 06/06/2016). Others, in the case of Victor, viewed success in advanced math as a game "too hard" for him and with rules and skills that he "can't really do

anything with" as a prospective law enforcement officer (Personal Interview, Victor, 03/28/2016). Nigel and Felix, who showed very little interest in honor's pre-calculus but were quick to grasp the most abstract of mathematical concepts, viewed college math as a hassle that would interfere with the non-academic aspects of their lives after high school. Thus, 5 out of the 7 participants who identified as math people during the course of this study, chose majors and career paths that, in their eyes, did not require advanced college level math and subsequently would not pose further threats to their mathematics identities.

Kawhi and Andre were the only students contemplating math-focused college majors after high school. Kawhi continued to experience success in honor's pre-calculus while Andre struggled and showed very little interest the whole year. In fact, during his first interview, Andre conceded that he never studied for honor's pre-calculus; he also confessed that he needed to drastically change his studying habits in college in order to succeed (Personal Interview, Andre, 03/18/2016). Nonetheless, both students ended their K to 12 math education interested in majoring in accounting. Kawhi's reason was that he was a very logical person with the "personality" suited to math oriented careers (Personal Interview, Kawhi, 06/01/2016). Similarly, Andre taught of himself as a math person because of the "passion" he harbored for learning and doing mathematics (Personal Interview, Andre, 03/18/2016). Kawhi and Andre interpreted their history of success in mathematics classrooms as more than just identification with the domain. Unlike other participants, they perceived their experiences in K to 12 math education as evidence that they were biologically predisposed for careers requiring advanced college math courses. The critical finding here is that students defined a math person as a great thinker born with special

talents; secondary mathematics education forced some to avoid higher level math to preserve their math identities while others are challenged to conceive of their positive identification with the domain as a personality trait.

On the other hand, for other participants like Kendrick and Shalik, secondary education constituted a process of dis-identification with mathematics (Steele, 1997). Kendrick recounted being given more advanced math problems on the board in elementary school; similarly, Shalik was always called on to demonstrate to this other middle school aged classmates how to solve a math problem. Both participants' positive math identities developed before high school became untenable by senior year. For Kendrick, honor's pre-calculus cemented the fact that he could no longer conceive of himself as "a great thinker" who knew "everything that they [were] taught up to this point" (Personal Interview, Kendrick, 04/11/2016). Likewise, Shalik, in spite of being one the highest performing students in honor's pre-calculus and his high level of engagement in class, no longer identified as a math person because he was convinced that he could not solve every pre-calculus level problem "thrown" at him (Personal, Interview, 02/05/2016). So, for these two students, their math identity seemed adversely affected by the increase level of abstraction and sophistication in K to 12 mathematics education. Their dis-identification with mathematics appeared to have stemmed more out of their inability to construct meaningful connections to honor's pre-calculus than their math ability or success.

This was further evidenced in my observation and interview transcripts of Tamika and Stephanie, one the most studious and highest performing students in the honor's pre-calculus class. They were the only participants who never identified with mathematics and summed up

their experiences in math classrooms as a struggle. Even in elementary and middle school where gender-based differences in math performance and success are mostly insignificant (e.g. Beaton, Mullis, Martin, Gonzalez, Kelly & Smith, 1996; Chipman, 1996), Tamika's interpretation of success in mathematics was that she "studied as hard as [she] could and got a good grade" (Personal Interview, Tamika, 05/04/2016). Similarly, Stephanie dismissed her success before and in honor's pre-calculus because she perceived mathematics as a "bunch of rules" that she never "understood" (Personal Interview, Stephanie, 06/07/2016). Tamika echoed Stephanie's sentiments and added that the academic domain did not seem to value creativity and curiosity. Both participants were lauded by their peers and teachers for their hard work, academic devotion, and their leadership; however, the "socially produced and culturally constituted activities" (Holland, Lachicotte, Skinner, & Cain, 1998, pp. 40-41) they have experienced in mathematics classrooms have made it impossible for them to develop and cultivate any meaningful identification with mathematics.

How does race affect black student's math confidence and sense of belongingness to the academic domain?

None the participants in this study viewed themselves and their fellow classmates as belonging to the community of math learners and doers. 9 out of 11 students interviewed for this study failed to identify another classmate from Ms. Turner's honor's pre-calculus as math people. This was in spite the fact that the majority of the participants identified as math people and that most of the students in the classroom observed for this study have known each other for the bulk

of their four years at Oxford. In fact, Tamika believed that some participants, like her close friend Weldon, only identified as math people to rationalize and justify their struggles in other disciplines like English. She and Shalik dismissed the notion of being honor's students altogether. They viewed a classroom of black students from Oxforddm Oxfordy of the participants identified as math people and that most of the students .

Meanwhile, all of the participants in this study conceded that their image of a member of the community of math learners and doers was that of an Asian or white person. Each participant recounted instances in mainstream media, schools, and their communities where they became aware or were convinced of the belief of a racial hierarchy of mathematics ability (Martin, 2009). Kendrick, born in Jamaica, had only been in the U.S. three years during the time of this study confessed that he believed Asians were smarter than blacks because it was mentioned on separate occasions on television. Similarly, Shalik thought "Caucasian[s]" were superior in mathematics because a white person holds the Guinness World Record "for solving the longest math problem;" he coupled this with his experiences in racially segregated suburban schools where he witnessed "Caucasian kids" excelling in math compared to Oxford where he was "not around many African Americans who do" (Personal Interview, Shalik, 02/05/2016). In Tamika's case, mainstream beliefs about a racial hierarchy of math ability were crystalized by her parents and relatives who would point to the race of some her classmates as explanation for their academic successes. Most of the participants expressed or emoted shame in their recounting of how they came to believe the perceived inferiority of black students in mathematics. In fact, Kawhi, in an attempt to fight against those stereotypes, characterized the pervasiveness of race-based beliefs

in math education as a conspiracy to 'keep black people down;' he also believed that the mathematicians who have been celebrated the most throughout the discipline's history, like Albert Einstein, are of African origins.

However, none of the participants thought there was a relationship between being stereotyped as low ability in the field of mathematics and not perceiving themselves as members of the academic domain. Participants, like Kawhi and Weldon, who perceived being African Americans as having to "make a difference" and being better than average, drew a distinction between identification and membership. They viewed membership as a level of engagement and dedication that they were not interested in. Other participants, like Stephanie and Nigel, who described being black as a social responsibility and the motivation behind their history of academic success, saw membership to the community of math learners and doers as a personal choice and outside of their perceived duty to fight against the pervasive belief that black students are mathematically inept. Thus, the mathematics identities of the participants of this study, regardless of their accumulated experience in K to 12 math classrooms, their level of identification or dis-identification with the discipline by senior year, comprise of "ideas and subjectivities" that come "into existence and …limit what is possible" in students' conception of mathematics education (Allan, 2011, pp. 276-277; see Foucault, 1984/1990b). In other words, mathematics classrooms, particularly in secondary education, did not afford this study's participants the critical space needed to "discover that these orders [in math education] are perhaps not the only possible ones or the best ones" for them and their futures (Foucault, 1966/1994b, p. 20). Instead, students completed high school with a perception of mathematics as

an academic domain reserved for a selected few and math identities limited by a larger narrative of race-based math ability.

CHAPTER 5

CONCLUSION

This dissertation examined high achieving black students' perception of mathematics education and identification with the discipline. I used of ethnographic methods in collecting and analyzing students' math experience and identity. Ethnographic methods allowed for a nuanced and layered analysis of participants' interpretation of their experiences in K to 12 math classrooms and their sense of belonging to mathematics as an academic domain.

This study addresses a gap in the extant literature concerned with race-based differences in students' math performance and achievement. Most studies tend to focus or highlight black students' failure or underachievement in mathematics classrooms (e.g. Anderson, 2009; Hale, 2001; Hernstein & Murray, 1994; Ladson-Billings, 2006; Martin, 2009a, 2009b, 2009c, 2009d, 2012; McGee, 2009; McLoyd, 1991). Some scholars observed that the preponderance of studies focused on black students' failure in mathematics education compared to the dearth of scholarship on high performing black students has corroborated mainstream beliefs of a racial hierarchy of mathematics ability (Martin, 2009). The participants selected for this study were spread across the ability and confidence level continuum; however, the students selected were among the "10 percent of American children [to] complete the sequence of high school mathematics—algebra, geometry, trigonometry, and pre-calculus—that are required in many other countries" (McGee & Martin, p. 48; see Schmidt, 2003). Thus, this study, consistent with a growing number of educational researchers concerned about racial minority students' mathematics identity construction (e.g. Cobb, Gresalfi, & Hodge, 2008; Frankenstein, 1983;

Freitas, 2008; Gower, 2015; Greer & Mukhopadhyay, 2003; Gutierrez, 2008; Martin, 2000; Martin, Gholson, & Leonard, 2010; McGee & Martin, 2011; Reyes & Stanic, 1988; Tate, 1994; Tate & Rousseau, 2003), sought to gain a deeper understanding of 11 black students' interpretation of their history of success in math classrooms and being stereotyped as low ability in mathematics education.

In order to fully examine how students reconciled being in honor's pre-calculus and mainstream beliefs of their mathematical ineptitude, I made use of the construct of confidence defined as "a sense of belongingness" (Darragh, 2013). Participants' identification with mathematics was extended beyond "cognition, achievement, or performance, but rather" included "the whole person and how they 'bec[a]me' a learner of mathematics" (Darragh, 2013, p. 216; see also Lerman, 2009). Thus, data collection and analyses of students' math confidence elicited "references to [larger] social practices," like students' racial identity and perception of the role race plays in their lives. This study borrowed from Varelas, Martin and Kane's (2012) content learning (CL) and identity construction (IC) framework combined with Holland et al.'s (1998) concept of figured worlds to examine and offer insights into how race affects students' perception of and identification with mathematics.

The study was conducted at Oxford, a comprehensive, under-resourced, and low performing public high-school in the district of Philadelphia. Ms. Turner's honor's pre-calculus classroom was observed for the entire 2015-2016 academic year. Most of the students from Ms. Turner's classroom were part of a college pipeline program sponsored by a renowned law firm in Philadelphia in partnership with Cecil B. "Moore" University. By the end of this study, the

overwhelming majority of the students in the honor's pre-calculus had fulfilled their requirements for graduation and were accepted or deciding on a college. The participants selected for this study represented a small sample of what some scholars would describe as Oxford's "resilient children…actively engaged in schools…and maintain[ing] healthy expectations" in spite of the systemic and persistent failures of their institutions. (Borman & Rachuba, 2001, p. 2; see Finn & Rock, 1997).

Students' identification with mathematics

Nine participants described their overall experience learning and doing mathematics as mostly positive. They each recounted instances in elementary or middle school where teachers or other adults in their lives subliminally or overtly led them to believe they had a natural aptitude for mathematics. Some students, like Felix and Nigel, could not explain or remember how they realized they were math people; both believed they always knew, at least as far back as their first memories of being in school. Others, like Tyronne and Kendrick, remembered being used as exemplars during math lessons in middle school. Similarly, Kawhi, believed to have taken after his uncle's gifts for numbers, expected to follow in his footsteps and lead an economically successful life.

Nonetheless, as students were making decisions about their academic lives and future after high-school, identification with mathematics became more complicated and more nuanced than the competence-confidence combination. For instance, Kendrick and Shalik no longer identified as math people during the course of this study. The former, who defined a math person as a great thinker, blamed his dis-identification with mathematics on his first two years at Oxford

without mathematics teacher or quality math instruction. Shalik, on the other hand, performed well in honor's pre-calculus, but still perceived secondary math education's increased level of abstraction as indication that he could no longer identify as a math person; nor could he ever pursue a math-oriented college major. Other participants, like Tyronne and Victor, still identified as math people in spite of their struggles in high school math; however, they viewed advanced math courses as a hard "game" unnecessary for their career paths. Similar beliefs were shared by Weldon, the school's valedictorian and one of the few participants who tested into an advanced college math course. However, he elected to enroll into introductory college algebra because he failed to see the value of higher level math for a nursing major. The interesting pattern here is that a group of seniors, praised for their math abilities most of their K to 12 schooling experience, had to either dis-identify with mathematics or dismiss college level math courses as useless and unrelated to their envisioned lives postsecondary education.

Unlike the other participants, Kawhi and Andre, who believed to be math people at the time of this study, thought they were biologically predisposed for a career in accounting. Kawhi believed to be a very logical person, "good with numbers" just like his uncle who achieved great economic stability as an accountant; he contrasted his uncle's good fortunes to his mother whom he described as having always struggled financially (Personal Interview, Kawhi, 02/01/2016). Andre thought his passion for learning and doing mathematics which he inherited from his father gave him an edge over his fellow classmates in the honor's pre-calculus class. In spite the fact that he showed very little interest in math his senior year, and that he had not applied to any colleges by the time of this study, he was certain that his passion for mathematics was going to

yield a degree in accounting and a successful economic life (Personal Interview, Andre, 03/18/2016). Like the other students interviewed, Kawhi and Andre described a math person as someone born with natural talents suited to excel in mathematics; however, they were the only participants who expressed beliefs that they possessed those natural talents. They were the only students who translated their history of successes in elementary and middle school math classrooms as biological traits which remained unscathed by their secondary education experiences. The critical point here is that students who have cultivated positive identification with mathematics throughout most of their schooling are still susceptible to dis-identify with mathematics or avoid higher level math courses after high-school unless they are able to interpret success in math classrooms as an immutable personality trait.

The notion of a math person as someone born with math genes is particularly intriguing when considering the fact that Tamika and Stephanie, the only girls in this study, were the only participants who never thought of themselves as math people. They were considered by their teachers and peers to be the hardest working, most studious and among Ms. Turner's most academically gifted students. However, they both interpreted their success in honor's pre-calculus and in previous math classrooms as simply the result of hard work. Tamika thought herself to be too creative to be a math person. Stephanie believed math to be a bunch of rules she could never remember when or how to apply. Gender is beyond the scope of this study, and neither of the participants pointed to their gender identity as why they never identified with mathematics. Nonetheless, two high performing girls incapable to identify as math people warrants further investigation of students' conception of a math person as someone born with

natural abilities in relationship to mainstream "perception of mathematics as a content area more exclusive to males" (Harkness & Stallworth, 2013, p. 330; see also Beane, 1988; Forgasz, Leder & Kloosterman, 2004; Kloosterman, Tassell, Ponniah & Essex, 2001; Sells, 1973). Tamika alluded to this in her description of her overall experience learning and doing mathematics. She explained that "since [she's] a girl," mathematics seemed relevant "when it comes to shopping;" otherwise, it is a bunch of "formulas" (Personal Interview, Tamika, 05/04/2016). This is further evidence that more studies concerned with differences in students' math performance should focus on students' math identity construction and the roles gender and race play in students' perception of mathematics education.

Race's impact on students' sense of belonging

Another critical aspect of students' conception of a math person is their belief that Asians and whites were mathematically superior than blacks. Every participant, regardless of their identification with mathematics, conceded that there existed a racial hierarchy of mathematics ability. They each recounted how mainstream media, the classroom or their community has introduced and affirmed the notion that Asians and white students were superior in mathematics. This was coupled with the fact that 9 out of the 11 participants could not identify any other students from Ms. Turner's honor's pre-calculus as math people. Tamika and Shalik went further; they rejected being honor's students as any indication of academic success because Oxford was not a "special admission" high school and its students were from the neighboring low income community (Personal Interview, Shalik, 02/05/2016). It was evident that this study's

participants were acutely aware of and affected by the pervasive belief that black students are academically inferior to their Asian and white counterparts.

The impact of race-based stereotypes was juxtaposed to participants' unbending sense of responsibility and mission to prove disparaging beliefs about African Americans wrong. Many students shared moments in their lives when their race became a salient aspect of their understanding and position in the world. For instance, Kawhi stumbled upon a book on the killing of Emmett Till in middle school; he became conscious that his skin color may elicit reactions and actions from others that are not motivated by reason or warrant proof. Nigel recounted separate instances at Oxford when he had to convince a teacher and a school counselor that he was an honor student and not a gangsta. However, many of the participants seemed adequately equipped "to cope with the dominant culture's disparaging views of their group" (Coard, Wallace, Stevenson, & Brotman, 2004). Some participants described being black as a fight against negative stereotypes and the need to exceed expectations. Others believed their academic achievements to be correlated to their perceived duty to disprove derogatory views of black students. Many attributed this to their upbringing and their racial socialization process which provided them "protection against racism, pride and heritage about…the black experience, and the need to succeed within mainstream [white] America" (Strauss & Cross, 2005, p. 68).

However, students' perceived social responsibility to exceed academic expectations did not seem to translate into a sense of belongingness to the math community. Students were all acutely aware of black students being stereotyped as mathematical failures; nonetheless, none of the participants expressed interest in seeking membership into the academic domain. Students

like Kawhi and Weldon who identified as math people distinguished between identification and membership. Weldon believed membership meant becoming a "math teacher" (Personal Interview, Weldon, 05/24/2016); and Kawhi saw being a member of the math community as "constantly…looking for new ways to develop in mathematics" (Personal Interview, Kawhi, 06/01/2014). Both students failed to close the gap between their "actual" math identities, constituted of mostly positive experiences in math classrooms, and their perceived "designated" identity of a doer of mathematics, constituted by a larger narrative of what it means to belong to the math community (Sfard and Prusak, 2005, p. 18). In other words, in spite of their success in math and positive identification with the domain, they remained rather "limited" given the "identities being offered to them" (Urrieta, 2007, p. 111). They needed more evidence than a history of success in mathematics education, being enrolled and performing well in honor's pre-calculus to claim or seek membership into the academic domain.

Moreover, participants saw belonging to the math community as a personal choice unrelated to and outside of their mission to use academics to challenge negative views of African Americans. Stephanie explained that a classroom of students from different racial backgrounds was always "stressful" to her because she had to be careful not to legitimate any beliefs about the academic inferiority of African American students. However, when it comes to mathematics she "wouldn't care if someone came up to me and said 'you know black people don't like math'" (Personal Interview, Stephanie, 06/07/2016). This was after she argued that "individuals" have the power to "change" stereotypes. Other participants shared Stephanie's views about exceeding expectations in mathematics as more of a personal choice. None of them felt compelled to claim

or seek membership into the academic domain as a continuation of their view of what it means to be black in America. Thus, a group of honor's students with a proven record of success in math classrooms, and a strong perception of being black as a social responsibility, were unable to develop a sense of belonging to the math community as a part of their mission to challenge notions of black students' academic inferiority.

This study of a group of honor's students from Oxford addresses the dearth of scholarship on high performing black students in mathematics. This research advances insights about black students' perception of and identification with mathematics in response to mainstream beliefs of a racial hierarchy of mathematics ability in the United States.

Data collected and analyzed for this study showed that students defined a math person as someone biologically predisposed to succeed in mathematics. In spite the fact that many of the participants experienced success in mathematics and identified as math people as some point during their K to 12 education, they were convinced that they were not predisposed to succeed in math-oriented careers.

Similarly, participants expressed strong positive identification with being African Americans and an insatiable need to use academics to reject negative stereotypes about being black Americans. However, none of them thought pursuing college and professional careers in math related fields as part of their social responsibility.

Implications and Recommendations

This ethnographic study of a group of black students in honor's pre-calculus offered new insights into students' math identity construction and perception of mathematics education,

particularly concerning the role race plays in students' academic identity. The participants selected for this study were part of a college pipeline sponsored by a renowned firm in the city of Philadelphia and supported by Cecil B. "Moore" University's faculty staff and doctoral students in the department of education. Students benefitted from resources like access to mentoring, portable computers, richer mathematics curricula, more rigorous and individualized instructions. However, only 2 out the 11 participants contemplated math-related majors and careers after high-school.

Implications for policy and practice

This study echoed other scholars' call for new policy and curricular initiatives aimed at challenging the under representation of black students in STEM fields (e.g. Fouad & Smith, 1996; Lee, 2002; Lent 1998; Schoenfeld, 2002; Tate, 1997). More specifically in secondary education where the majority of this study's participants either dis-identified with mathematics or developed a perception of college level mathematics courses as wasteful. Gutstein (2006) attributed this to the fact that teacher training programs, pedagogies and mathematical content are mostly centered around "classical" mathematics. Students from low income communities, like this study's participants, often exhibit greater difficulty "setting their reality aside to engage in mathematics classroom investigations that do not connect to their reality" (McNair, 2000, p. 559; see also Bruckerhoff, 1995). Thus, math classrooms disconnected from students' lived experiences or that require students to set their realities aside are likely to alienate the same groups of students, perpetuate the race-based achievement gap in mathematics education, and legitimate race-based beliefs of a hierarchy of math ability.

Disrupting this cycle means developing mathematics classrooms and experiences where this study's participants can connect their perceived social responsibility to their learning. Gutstein (2006) asserted that mathematics education for black students from under privileged communities like Oxford should help students develop "sociopolitical consciousness of the conditions of their lives; a sense of social agency…and positive social/cultural identities" (p. 332). This way of conceptualizing mathematics education as a tool for social and political empowerment is what many scholars in the field refer to as mathematics for social justice. Students will engage with mathematical concepts and skills in order to make sense of their worlds and potentially begin contemplating solutions or evidence-based plans to a more equitable future.

The reconceptualization of math instructions and curricula should be coupled with more efforts from policymakers and institutions to eradicate "color-blindness" out of teacher education programs and professional developments (Gay, 2002; Ladson-Billings, 2009; Tate & Rousseau, 2003). Colorblind assumptions are even more prevalent in mathematics and science education. Some scholars found that educators in those fields, when prompted, were more likely to claim that they do not see "racial differences" and did not account for them in their lesson plans and instructions (Gay, 2002; Ladson-Billings, 2009; Tate & Rousseau, 2003). One key reason Gay (2002) observed is that mathematics teachers' belief that it would cause "too much of a conceptual and substantive stretch for their subjects to maintain disciplinary integrity" (Gay, 2002, p. 107). She attributed this to the fact that teachers' multicultural knowledge often fails to extend beyond selected high-profile racial or/and ethnic minority figures in entertainment or

politics, and doesn't include "less visible but very significant contributions of ethnic groups in science, medicine, technology, math…" (p. 107). The potential adverse effects of color-blindness on students is compounded by the fact that only 18% of the teaching workforce are people of color (Boser, 2014, p. 2). Tate and Rousseau (2003) underlined that white teachers in their reflections on equity were more likely to adopt color blindness out of fear of stereotyping racial and ethnic minority students (p. 213). In their view, acknowledging students' racial differences is synonymous to harboring racist sentiments towards students. A teaching workforce overwhelmingly white and fearful of adopting culturally sensitive practices creates learning environments where the average teacher is pedagogically unprepared and ideologically unmotivated—in some cases, opposed to creating culturally competent opportunities for students to develop more positive personal and academic identities, particularly in disciplines like mathematics.

Implications for future research

This study provided a deeper and more nuanced understanding of black students' math identity in relationship to their racial identity and mainstream race-based beliefs that pervades mathematics education. Moreover, this study has substantiated the calls of educational researchers, practitioners and students to reevaluate our understanding of mathematics education, and begin the reimagining process of allowing students and teachers in math classrooms across the U.S. to experience mathematics more meaningfully and more purposefully.

However, more research on students' mathematics identity and perception of mathematics education is needed, particularly for black students and other racial minority students who are perceived to be "in the lowest tails of academic achievements" (Tate & Rousseau, 2002, p. 210). A deeper and more nuanced understanding of how constructs like race, gender and social class individually and collectively inform students' academic identity development will allow for greater insights into race-based and gender-based performance gaps. Moreover, more studies should focus on students who cultivated positive identities with an academic domain, like mathematics, in elementary and middle school but feel compelled to dis-identify with the domain in secondary school or college. Finally, there should be greater attention paid to high achieving black and other racial minority students in the field of mathematics education. Developing a more complex understanding of how students stereotyped as academically inferior make sense of academic success in relationship to their collective identity content and their actual identity is imperative in challenging mainstream race-based beliefs that pervade academia and the classroom.

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APPENDIX A: SURVEY ON MATHEMATICS CONFIDENCE

Name:_____ Date:_____

1: Confident 2: Somewhat Confident 3: A little Confident 4: Not Confident

#	**Questions**	**1**	**2**	**3**	**4**
1	I understand the math that I'm doing in this course.				
2	I will do well in this course.				
3	I am ready for more difficult college math courses				
4	I can do well in majors that require advanced math courses.				
5	I will pursue careers that involve knowing and using some advanced math concepts.				
6	I will likely go into careers that require a lot of college mathematics				
7	Mathematics is one of my favorite subjects.				
8	I will use mathematics outside of the classroom				
9	I'm a part of the learners and doers of the mathematics community.				
10	Mathematics will play some role in my future.				

APPENDIX B: PROTOCOL ON ACCUMULATED EXPERIENCES IN MATH

1. What is your general feeling about mathematics? Can you explain what you mean?

2. How has your experience in mathematics classrooms been? Can you give an example?

3. Do you think that there's such a thing as math person? How would you define a math person? Or what does a math person look like to you? Can you give an example?

4. Are you a math person? Why or why not?

5. Were you ever a math person? How did you figure out that you were or were not a math person?

6. Do you have any friends in/out of school that are math people? Can you explain why you think that?

7. Do you have any family members that are math people? Can you explain why you think that?

8. Can you think of a time or moments in your life where you felt like you were a math person?

9. Can you think of a time or moments in your life where you felt like you were not a math person?

10. How important is math to you? How important is math to the kind of life you want to have?

APPENDIX C: PROTOCOL ABOUT STUDENTS MATH CONFIDENCE

1. How would you rate your overall confidence in math (from 1 to 10 or high, medium or low)? What is the meaning of that rating?

2. What would you say is the number one reason for your level of confidence in mathematics? Can you explain why?

3. What do you think it means to learn mathematics? How much of this do you think is the reason for your level of confidence in mathematics? Explain.

4. Some researchers in the field define math confidence as "a sense of belongingness" to the community of math learners and doers. What does this mean to you?

5. Do you feel like you belong to the community of math learners and doers? Why do you think that is? Can you give an example?

6. When did you realize that you were/were not a member of the math community? Can you explain what specifically happened? Or can you describe that moment?

7. How much of your sense of belonging/not belonging to the math community do you think contributes to the amount of effort that you usually put into your math classes?

8. Being a member of a racial minority group often means being subjected to various negative racial characterizations. In math for instance, there this perception that Asians and whites are better in math than blacks. Are you aware of this? When or how would you say you became aware of this?

9. Do you think it easier or harder for black students to feel that they belong to the community of math learners/doers? Can you explain what you mean?

10. What does it mean to be black to you? Can you explain?

11. Have you ever thought of the kind of impact that being black has on your sense of belonging/not belonging to the math community of learners? If not, then what kind of impact do you think that being black has on a student's sense of belonging to the math community of learners? Can you explain?

12. What are some things that these questions made you think/talk about that you never had to before?

13. What is a question that you'd like to ask me?

APPENDIX D: INFORMED CONSENT-ASSENT FOR PARTICIPANTS UNDER 18

Dear Student,

Congratulations on your acceptance into the College Pathways program at Frankford High School. Your success in college depends on how well prepared you are to meet the academic and emotional challenges you will face there. This year you will be taking courses in English and Math that have been designed to help prepare you for such challenges.

As members of Temple University's College of Education who are involved with this program, we're conducting research to help discover whether our efforts to prepare you for college are successful. We're writing to ask your permission to participate in this research. Throughout the school year, you'll be doing assignments and participating in activities as part of this program. If you'd like to contribute to the research, some of the things you do for class will be collected and used in the study. Additionally, you may be asked to talk with a member of the research team about your experiences with specific assignments and activities throughout the school year. These conversations will be audio recorded.

The title of the study is: Preparing students for college: Examining the effectiveness of a College Pathways program. The researchers involved are Professors Michael W. Smith and Kristie Jones Newton, and doctoral students Jon-Philip Imbrenda and Thierry Saintine, all from College of Education.

Here are some things you should know about the research study:

- Someone will explain this research study to you.
- You volunteer to be part of the study.
- Whether you take part is up to you.
- You can choose not to take part in the research study, in which case your work will not be included.
- You can agree to take part now and later change your mind.
- Whatever you decide, it will not be held against you.
- Feel free to ask all the questions you want before and after you decide.
- By signing this consent form, you are not waiving any of the legal rights that you otherwise would have as a participant in a research study.

The estimated duration of your study participation is September 1, 2015 to June 15, 2016.

The study will involve the following things. All of these are part of your regular classroom learning.

- You will be tested at the beginning and end of the school year to assess your reading, writing, and problem-solving
- Your class and homework assignments will be collected throughout the school year.
- A member of the research team may ask to talk with you individually about specific assignments.
- You may be asked to talk aloud while you work on a reading assignment or mathematics problem in the presence of a member of the research team.
- At the beginning and end of the school year, you will complete a brief survey in which you describe your study habits and attitudes toward school.

The benefit you will obtain from the research is knowing that you have added to the understanding of this topic, and you will benefit from additional teachers and instruction tailored to your specific goals.
If you choose not to participate, you'll still be doing the same classwork. We just won't be using your words when we report the results. Please contact the research team with questions, concerns, or complaints about the research and any research-related injuries by calling 856-366-9812, or by emailing Jon-Philip Imbrenda at jay.imbrenda@temple.edu; or calling 212-283-6802 or emailing Thierry Saintine at thierry.saintine@temple.edu.

This research has been reviewed and approved by the Temple University Institutional Review Board. Please contact them at (215) 707-3390 or e-mail them at: irb@temple.edu for any of the following: questions, concerns, or complaints about the research; questions about your rights; to obtain information; or to offer input.

Confidentiality: Efforts will be made to limit the disclosure of your personal information, including research study records, to people who have a need to review this information. However, the study team cannot promise complete secrecy. For example, although the study team has put in safeguards to protect your information, there is always a potential risk of loss of confidentiality. There are several organizations that may inspect and copy your information to make sure that the study team is following the rules and regulations regarding research and the protection of human subjects. These organizations include the IRB, Temple University, its affiliates and agents, Temple University Health System, Inc., its affiliates and agents, the study sponsor and its agents, and the Office for Human Research Protections.

Your name will never be used in reporting the results of this study.

Your signature documents your permission to take part in this research.

DO NOT SIGN THIS FORM AFTER THIS DATE →

Signature of subject	Date

Printed name of subject

Signature of person obtaining consent

Printed name of person obtaining consent

Signature of witness (required)

Printed name of witness (required)

Because the research requires recording your voice, please indicate if you are willing to be audiotaped by checking either Yes or No below.

I give my permission for these tapes to be used from: September 1, 2015 to completion of the study.

Data will be stored for three (3) years after completion of the study.

I understand that I can withdraw my permission at any time. Upon my request, the audiotape(s) will no longer be used.

Yes ____ No_____

APPENDIX E: INFORMED CONSENT-PARENT PERMISSION FORM

Dear Parent or Guardian,

In collaboration with Temple University, Frankford High School is offering a program to help prepare students for success in college. The program will take place in specially-designed English and Math courses. Your child has been selected for these courses. Congratulations on this wonderful opportunity.

As members of Temple's College of Education who are involved in this program, we're writing to ask your permission to include your child in a study. The study will help to determine how successful we are in meeting our goal of preparing your child for college. If your child participates, work that he or she completes throughout the school year, as well as spoken accounts of his or her experiences in the program, may be included in the study. These conversations will be audio recorded.

The title of the study is: Preparing students for college: Examining the effectiveness of a College Pathways program. The researchers involved are Professors Michael W. Smith and Kristie Jones Newton, and doctoral students Jon-Philip Imbrenda and Thierry Saintine, all from the College of Education.

Here are some things you should know about the research study:

- Someone will explain this research study to your child.
- Your child can volunteer to be in a research study.
- Whether your child takes part is up to you.
- Your child can choose not to take part in the research study, in which case his or her work will not be included.
- Your child can agree to take part now and later change his or her mind.
- Whatever you decide, it will not be held against you.
- Feel free to ask all the questions you want before and after you decide.
- By signing this consent form, you are not waiving any of the legal rights that your child otherwise would have as a participant in a research study.

The estimated time in which your child will participate is September 1, 2015 to June 15, 2016.

The study will include the following things, all of which are part of regular classroom activity:

- Your child will be assessed at the beginning and end of the school year on reading, writing, and problem-solving.

- Your child's class and homework assignments will be collected throughout the school year.
- Your child may be asked to talk with a member of the research team about his or her experiences with specific assignments.
- Your child may be asked to talk aloud while working on a reading assignment or mathematics problem in the presence of a member of the research team.
- Your child will complete a brief survey at the beginning and end of the school year to help describe his or her study skills and attitudes toward schooling.

The benefit you will obtain from the research is knowing that you have contributed to the understanding of this topic, and your child will benefit from the involvement of additional teachers as well as instruction tailored to his or her individual needs. If you choose not to have your child participate, he or she will still be doing the same work. We just won't be using your child's words when we report the results.

Please contact the research team with questions, concerns, or complaints about the research and any research-related injuries by calling 856-366-9812 or emailing Jon-Philip Imbrenda at jay.imbrenda@temple.edu; or calling or calling 212-283-6802 or emailing Thierry Saintine at thierry.saintine@temple.edu.

This research has been reviewed and approved by the Temple University Institutional Review Board. Please contact them at (215) 707-3390 or e-mail them at: irb@temple.edu for any of the following: questions, concerns, or complaints about the research; questions about your rights; to obtain information; or to offer input.

Confidentiality: Efforts will be made to limit the disclosure of your personal information, including research study records, to people who have a need to review this information. However, the study team cannot promise complete secrecy. For example, although the study team has put in safeguards to protect your information, there is always a potential risk of loss of confidentiality. There are several organizations that may inspect and copy your information to make sure that the study team is following the rules and regulations regarding research and the protection of human subjects. These organizations include the IRB, Temple University, its affiliates and agents, Temple University Health System, Inc., its affiliates and agents, the study sponsor and its agents, and the Office for Human Research Protections.

Your child's name will never be used in reporting the results of this study.

Signature Block for Children

Your signature documents your permission for the named child to take part in this research.

DO NOT SIGN THIS FORM AFTER THIS DATE →

Printed name of child

Signature of parent or guardian — Date

Printed name of parent or guardian

❑ Parent
❑ Guardian

Signature of person obtaining consent and assent — Date

Printed name of person obtaining consent and assent — Date

Because the research requires recording your child's voice, please indicate if you are willing to allow your child to be audiotaped by checking Yes or No below.

I give my permission for these tapes to be used from: September 1, 2015 to completion of the study.

Data will be stored for three (3) years after completion of the study.

I understand that I can withdraw my permission at any time. Upon my request, the audiotape(s) will no longer be used.

Yes ____ No_____

APPENDIX F: INFORMED CONSENT-ASSENT FOR PARTICIPANTS 18 OR OLDER

Dear Student,

Congratulations on your acceptance into the College Pathways program at Frankford High School. Your success in college depends on how well prepared you are to meet the academic and emotional challenges you will face there. This year you will be taking courses in English and Math that have been designed to help prepare you for such challenges.

As members of Temple University's College of Education who are involved with this program, we're conducting research to help discover whether our efforts to prepare you for college are successful. We're writing to ask your permission to participate in this research. Throughout the school year, you'll be doing assignments and participating in activities as part of this program. If you'd like to contribute to the research, some of the things you do for class will be collected and used in the study. Additionally, you may be asked to talk with a member of the research team about your experiences with specific assignments and activities throughout the school year. These conversations will be audio recorded.

The title of the study is: Preparing students for college: Examining the effectiveness of a College Pathways program. The researchers involved are Professors Michael W. Smith and Kristie Jones Newton, and doctoral students Jon-Philip Imbrenda and Thierry Saintine, all from College of Education.

Here are some things you should know about the research study:

- Someone will explain this research study to you.
- You volunteer to be part of the study.
- Whether you take part is up to you.
- You can choose not to take part in the research study, in which case your work will not be included.
- You can agree to take part now and later change your mind.
- Whatever you decide, it will not be held against you.
- Feel free to ask all the questions you want before and after you decide.
- By signing this consent form, you are not waiving any of the legal rights that you otherwise would have as a participant in a research study.

The estimated duration of your study participation is September 1, 2015 to June 15, 2016.

The study will involve the following things. All of these are part of your regular classroom learning.

- You will be tested at the beginning and end of the school year to assess your reading, writing, and problem-solving
- Your class and homework assignments will be collected throughout the school year.
- A member of the research team may ask to talk with you individually about specific assignments.
- You may be asked to talk aloud while you work on a reading assignment or mathematics problem in the presence of a member of the research team.
- At the beginning and end of the school year, you will complete a brief survey in which you describe your study habits and attitudes toward school.

The benefit you will obtain from the research is knowing that you have added to the understanding of this topic, and you will benefit from additional teachers and instruction tailored to your specific goals.
If you choose not to participate, you'll still be doing the same classwork. We just won't be using your words when we report the results. Please contact the research team with questions, concerns, or complaints about the research and any research-related injuries by calling 856-366-9812, or by emailing Jon-Philip Imbrenda at jay.imbrenda@temple.edu; or calling 212-283-6802 or emailing Thierry Saintine at thierry.saintine@temple.edu.

This research has been reviewed and approved by the Temple University Institutional Review Board. Please contact them at (215) 707-3390 or e-mail them at: irb@temple.edu for any of the following: questions, concerns, or complaints about the research; questions about your rights; to obtain information; or to offer input.

Confidentiality: Efforts will be made to limit the disclosure of your personal information, including research study records, to people who have a need to review this information. However, the study team cannot promise complete secrecy. For example, although the study team has put in safeguards to protect your information, there is always a potential risk of loss of confidentiality. There are several organizations that may inspect and copy your information to make sure that the study team is following the rules and regulations regarding research and the protection of human subjects. These organizations include the IRB, Temple University, its affiliates and agents, Temple University Health System, Inc., its affiliates and agents, the study sponsor and its agents, and the Office for Human Research Protections.

Your name will never be used in reporting the results of this study.

Your signature documents your permission to take part in this research.

DO NOT SIGN THIS FORM AFTER THIS DATE →

Signature of subject | Date

Printed name of subject

Signature of person obtaining consent

Printed name of person obtaining consent

Signature of witness (required)

Printed name of witness (required)

Because the research requires recording your voice, please indicate if you are willing to be audiotaped by checking either Yes or No below.

I give my permission for these tapes to be used from: September 1, 2015 to completion of the study.

Data will be stored for three (3) years after completion of the study.

I understand that I can withdraw my permission at any time. Upon my request, the audiotape(s) will no longer be used.

Yes ____ No_____

APPENDIX G: LEVELS OF ANALYSES AND CODING

Stage I—Codes from field notes	**Stage II—Codes after first round of interviews**	**Stage III—Codes after second round of interviews**	**Stage IV—Codes after triangulating multiple data sources and using Dedoose's "Data Analysis" feature**
-Teacher Preparation (Ms. Turner's disinterest in planning; her reliance on tricks; her lack of focus during meetings) -Students' Engagement Level (Students' lack of interest in the course) -Oxford's culture Vs. Classroom culture -Ms. Turner's beliefs about students' ability -Ms. Turner's views of students' backgrounds -Ms. Turner's beliefs about teaching math -Security Officers (their interactions with students) -Nigel—the star, 'over-confident' student-athlete -Kawhi—the quiet, high-ability student -Tamika—the hardworking and very engaged student -Ms. Turner favors relational aspects of teaching math -Deficit oriented language	-Overall Math Experience (Mostly positive in elementary/middle-school; Secondary math education; Avoid higher level math) -Positive Experiences -Negative Experiences -Avoidance -Attitude -Achievement Paradox (students wanted good grades and were always checking their grades; they were not as motivated to complete work on time) -Math is a bunch of rules -A Math person is extraordinary, a great thinker -A math person is good with numbers -A Math person knows the basics -What does it mean to learn math? -College level math is a hassle -Math doesn't allow room for creativity	-Overall Math confidence -Students' perception of a math person -Students' Inability to view classmates as math people -Stereotypes—Asians and whites are smarter than blacks -Racial Identity (being black means better than average) -The Classroom as opportunity to prove stereotypes wrong -Racial Socialization -Strong positive identification with being black -Being black is a social responsibility -Math Identity -Sense of belonging -Membership Vs. Identity -Membership to math community is a personal choice -Membership is unrelated to students' perceived social responsibility	-Math Experiences • Mostly positive • Experiences used to delegitimize performance in honor's pre-calculus -A Math Person • Predisposed to succeed in math • Knows the rules • Good with money • A great thinker -Math Confidence • Discrepancy in confidence level scores • Sense of belonging • Not interested or capable of seeing themselves as members • Membership not part of their social responsibility -Racial Socialization -Racial Hierarchy of math ability

All the codes that emerged	Discarded Codes	Codes Used in presentation and discussion of data
-Teacher Preparation -Students' Engagement Level -Oxford's culture Vs. Classroom culture -Ms. Turner's beliefs about students' ability -Ms. Turner's views of students' backgrounds -Ms. Turner's beliefs about teaching math -Cecil B. "Moore" Student Teachers' experiences as a deterrent -Deficit oriented language -Students' culture as hindrance -Students' community as culturally deprived -Overall Math Experience -Positive Experiences -High School Math -Elementary/Middle-School Math -Negative Experiences -Avoidance -Attitude Achievement Paradox -A Math person is extraordinary -A math person is good with numbers -A Math person knows the basics -What does it mean to learn math? Overall Math confidence -Students' perception of a math person -Stereotype Threat -Racial Identity; Racial Socialization -Math Identity -Sense of belonging -What does it mean to be black? -Primacy given to relational Aspects of Teaching	-Teacher Preparation -Students' Engagement Level -Deficit oriented language -High School Math -Elementary/Middle-School Math -Negative Experiences -Avoidance -Students' community as culturally deprived -What does it mean to learn math? -Primacy given to relational Aspects of Teaching -Racial Socialization	-Math Experiences • Mostly positive • Variability in students' interpretation of success in math • Experiences used to delegitimize performance in honor's pre-calculus -A Math Person • Predisposed to succeed in math • Knows the rules • Good with money • A great thinker -Math Confidence • Discrepancy in confidence level scores • Sense of belonging • Not interested or capable of seeing themselves as members • Membership not part of their social responsibility • Students feel compelled to dis-identify to ensure successful academic and economic future