

## **ABSTRACT**

SMITH, AMBER ELYSE. Personal and Environmental Factors that Impact the Success of African-American High School Students in Mathematics. (Under the direction of Dr. Karen Keene).

Not enough research has been conducted to determine what can support and encourage successful African-American students in mathematics. Many environmental and personal factors have been identified that may impact the success of African-American students in mathematics but studying and relating these factors at a qualitative level would benefit from additional research (DeCuir & Dixson, 2004). The purpose of this research was to investigate a group of African-American students who are successful in mathematics, where success is defined as taking a higher-level mathematics course compared to others in the same grade and maintaining an A or B in that course. All participants in this study are students who identify as African-American and are currently enrolled in a magnet high school for academically talented students. An instrumental case study research design was used for the study. A survey that consisted of Likert scales was used to collect personal data, in addition to data that could be analyzed to determine the impact on the self-efficacy of the students in mathematics as it relates to environmental and personal factors of all the African-American students at the school. Nine students who participated in answering the survey questions were purposefully selected to participate in in-depth semi-structured interviews. The in-depth semi-structured interviews, which were audio recorded and transcribed, were used to collect responses from the participants. Qualitative analysis of the data in the form of creating themes from the interviews were used to delve deeply into the students' perceptions of their self-efficacy and personal beliefs as it relates to mathematics. In general, the results from this study provided confirmation of the findings from previous research. The most important findings discovered from this study were that the

parents and teachers of African-American students who are classified as successful in mathematics are supportive of them and there is some connection between self-efficacy and success for African-American students in math. This research study was significant because it gives an account of why African-American students were successful in mathematics in their own words.

*Keywords:* African-American, mathematics, success, self-efficacy, high school, parents, teachers, peers, encouragement, support

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Personal and Environmental Factors That Influence the Success of African-American High School Students in Mathematics

by  
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## **DEDICATION**

In honor of my mom, Pattie E. Smith, and in loving memory of my dad, Larry E. Smith, my grandma, Lillie B. Elliott, and my papa, Rev. James A. Elliott. I appreciate you all more than you can ever know for instilling in me at an early age the importance of education and learning for myself. Your encouragement and support through the years helped me to reach where I am, and I will be forever grateful.

## **BIOGRAPHY**

Amber E. Smith is the youngest of two children born to Pattie E. Smith and the late Larry E. Smith. She has an older brother, Avery, whose footsteps she has always tried to follow. Every summer, she spent time with her maternal grandparents, Rev. James A Elliott, and Mrs. Lillie B. Elliott, in a small rural town in northeastern North Carolina. It was during these summers that she developed a love of reading and music. Wanting to be a pediatrician for most of her childhood, she did not discover a love for mathematics until middle school when she then decided she wanted to be a mathematics professor. Prior to her journey through the mathematics doctoral program at NC State, she attended North Carolina Central University and obtained her bachelor's and master's degrees in applied mathematics. After graduating from NC Central, she began teaching as an adjunct developmental math instructor at Durham Technical Community College and Shaw University. Eventually, she became an instructor of mathematics at Vance-Granville Community college. Currently, Amber teaches Precalculus, AP Calculus BC, and Discrete mathematics at a local high school. In her spare time, Amber enjoys spending time with her mom, brother, aunts, uncles, her son, Aiden, and two "fur babies", Jack and Nika. She also loves watching sci-fi movies and listening to all types of music, with the hopes of one day learning how to play the bass guitar well enough to join a band.

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## **Chapter 1: Introduction**

### **Statement of the Problem**

Why are some African-American students successful in mathematics while others are not? Educational research has often focused on the negative aspects of the experiences of African-American students in mathematics, but research on students' success is also important (Ladson-Billings & Tate, 1995). Previous research has shown that numerous environmental and personal factors exist that could potentially impact the success of African-American students (Moody, 2004). To better understand what is happening, these factors should be examined simultaneously instead of separately. Of the research that pertains to African-Americans in mathematics, much of the research has been published on why African-American males perform poorly in mathematics courses (DeCuir & Dixson, 2004; Thompson & Lewis, 2005). There is a need for research to not simply focus on successful African-American males, but also African-American females, who are often overlooked (Morris, 2007).

### **Purpose Statement**

For the past fifty-two years, the US Department of Education and the Institute of Education Sciences have required the National Assessment of Educational Progress (NAEP) to assess students' understanding in mathematics, reading, science, social studies, and most recently, technology (The Nation's Report Card, 2019). The purpose of the assessments is to analyze how well students comprehend various subjects, as well as inform policymakers of the impact of curriculum changes (The Nation's Report Card, 2019). Fourth grade, eighth grade, and twelfth grade students take the assessments each year across the nation, and the results are analyzed nationwide, by state, and locally, categorized within groups that focus on race, socio-economic status, and location (The Nation's Report Card, 2019). Average scores are calculated

on a 0 to 500-point scale for groups of interest, for example by race/ethnicity (The Nation's Report Card, 2019). The National Assessment of Educational Progress reported a 32-point gap between African-American and Caucasian eighth grade students on the mathematics assessment in 2019, with a consistent gap of 31 to 41 points each year since 1990 (The Nation's Report Card, 2019). African-American students demonstrate low performance in academics, especially mathematics, compared to Caucasian students and as content increases in difficulty, African-American students' performance tends to decline (Martin, 2000). The purpose of this study is to investigate self-efficacy and the environmental factors that may relate to the success of African-American high school students in mathematics.

The data collected from a Likert scale survey will be used to determine connections among the environmental and personal factors and the success of African-American students in mathematics. The qualitative data gathered from interviews will be analyzed through the lens of Critical Race Theory, a theory that propounds that covert racism in the education system negatively influences the success of African-American high school students in mathematics (Delgado & Stefancic, 2001).

The ultimate purpose of the research is to promote change in education and increase the success rate of African-American students in mathematics by conducting a study of those deemed successful (as defined in this paper). Also, the findings may contribute to what is already known about closing the achievement gap between African-American students and Caucasian students in mathematics.

## **Research Questions**

This study will answer the following research questions:

1. What personal and environmental factors influence the success of African-American high school students in mathematics?
  - a. What impact does family interaction, particularly parental interaction, have on the success of African-American students in mathematics?
  - b. How do interactions with instructors impact the success of African-American students in mathematics?
  - c. What role does peer interaction play on the success of African-American students in mathematics?
  - d. How does socio-economic status influence African-American students being successful in mathematics?
  - e. What other environment factors may affect African-American high school students' success in mathematics?
2. How is self-efficacy related to success and the environmental factors mentioned previously?

## **Significance of the Study**

This study is significant in that it has the potential to help reduce the achievement gap between African-American and Caucasian students in mathematics. With an achievement gap that continues to widen, the likelihood an individual will graduate from college, or even high school, decreases (National Education Association, 2019). The level of education an individual obtains has been found to directly impact their socio-economic status (Coffee, et. al, 2013). Not obtaining a high school degree could potentially have a devastating impact on the future of the

individual, and lead to the continued cycle of low socio-economic status from one generation to the next (Coffee, et. al, 2013) Closing the achievement gap could conceivably propel African-American students out of this cycle. Additionally, identifying effective factors that influence the success of African-American students in mathematics may help African-American students perform better overall in mathematics. The information gathered from the study may also identify ways to promote positive self-efficacy in mathematics for African-American students.

Identifying teacher practices that help African-American high school students become successful in mathematics would be informative for current and future teachers. Learning about such practices would motivate current teachers to possibly change their approach to teaching African-American students in order to promote success in mathematics.

The study would provide parents and family members the understanding of the best practices they could use to help facilitate the success of their child, or relative, in mathematics. During parent-teacher conferences, teachers could inform parents and other family members how they are able to contribute to the success of the student in mathematics, even if they have little understanding of the concepts the student is learning.

Identifying how peers and the classroom/school environment influences the success of African-American students in mathematics would be another significant reason for the study.

### **Subjectivity Statement**

As an African-American female who pursued a degree in mathematics and currently teaches mathematics, I am biased in my viewpoint of the capabilities of African-American students in mathematics, as well as the negative implications typically presented by research. Coming from a household where my mom and dad were accountants and considered successful

in mathematics, I never realized that the general public believed African-Americans overall were not successful in mathematics.

My parents and maternal grandparents always encouraged me to do the best I could in school and told me I was capable of doing anything I set my mind to. With this mindset, I approached my studies with the notion that if I simply applied myself, I would be able to understand the concepts and perform well on assessments. I also have an older brother who received awards for his academic success, which led me to believe that I could earn academic awards too. Having a friendly sibling rivalry, I always wanted to prove that I was just as smart as my brother and capable of being successful in mathematics.

My second-grade teacher, Mrs. Simpson, was an African-American woman who reiterated what my family told me, in that I could do absolutely anything. She was the first teacher who pushed me beyond my comfort zone and for the first time, I was identified as academically gifted. In the previous two years of my academic schooling, I was placed in remedial classes as I was not outspoken, and my teachers believed I was not able to do the work and needed additional assistance. My second-grade teacher encouraged me to try harder problems and would often give me “challenge questions” if I finished my work early.

When I first started conducting research around mathematics education, I was alarmed that the literature I found suggested the majority of African-American students did not perform well in mathematics. This was contradictory to my lived experiences and those of my African-American friends, of which the majority went on to take Calculus while in high school. In one education course I enrolled in, I found literature that suggested teachers had the most impact on the success of African-American students, which also went against my experience. If I had believed what most of my teachers said about me, I would not have thought I could do well in

mathematics. For me, my parents were the most influential on my success and desire to do well in mathematics.

In conducting my research, it is important that I recognize the biases that I hold and focus on not allowing them to impact the articles I use or the findings I take away from them. Being able to recognize my biases will allow me to see the viewpoint of others and recognize that my experiences may not hold true to the lived experiences of others. At the same time, my biases will also help me understand that there is a possibility that other research may have taken place with a hidden agenda and I should not wholeheartedly view the findings of others as the only possible alternative.

### **Overview of Methods**

This research study used an instrumental case study design (Creswell, 2008). The case is the set of successful (in mathematics) African-American students at one magnet school designed for the academically gifted. The research was conducted in two phases which were tied together during analysis. The first portion of the study used a Likert scale to collect data that I used to characterize environmental and personal factors and how they are viewed by successful African-American students in mathematics. Specifically, using this survey data, I added values to the factors which had a positive impact or negative impact on the African-American high school students who are considered successful in mathematics.

Secondly, in-depth semi-structured interviews were used to collect responses from the participants. This allowed participants to give open-ended responses to a preselected list of questions that were designed for qualitative research (Creswell, 2012). It also allowed me to guide the participants without limiting their responses (Creswell, 2012). I audio recorded and transcribed each interview. The interviews permitted discovering similarities and differences

among the participants. I included four male and five female participants to allow for comparisons not only within ethnicity and race, but also across gender. Transcribing each interview helped to establish inductive codes and themes that emerged from the data analysis.

For the interview data analysis, I used in-vivo coding, a method where codes emerge from the data collected in the interviews (Miles, Huberman, & Saldaña, 2014). My goal for the research study was to capture the views of African-American students, as told by African-American students, and in-vivo coding granted me the ability to directly represent the voices of the participants. After I completed the first phase of coding and then used the codes that emerge, I completed the second phase of coding. From the second phase of coding I identified recurring themes that were used to answer the qualitative research questions.

**Definition of Terms** (discussion of these will be in the literature review)

- Success in mathematics: A student is successful in mathematics if they are
  - enrolled in a mathematics course that is at a higher level than what is the norm for their grade (including students who took Math I/Algebra I in 8th grade, or before)
  - or
  - enrolled in Calculus and beyond while in high school
  - and
  - Maintain an A or B while in a higher-level mathematics course.
- Personal factor: for this study, a personal factor is a factor/influence that comes from within the individual/participant, most notably, self-efficacy.
- Self-efficacy: how an individual view their ability to do well in a mathematics course.
- Environmental factors: a student's teachers, peers, classroom setting, and family members.

## **Limitations of the Study**

In this section, I discuss some limitations of the study, although because of the methodology I chose, they are not significant.

The first limitation of the study is that it was not conducted using a broad spectrum of African-American students. This is because all of the participants who were used in the study were considered successful in mathematics. This was done specifically to counter the negative narrative that is usually told regarding African-Americans and mathematics, as well as because the pool of students I had access to was at one school. This means that the findings may not be generalizable everywhere, but they hold true to the school used. However, because this was an instrumental case study, I believe there may be some generalizable findings as the case was not each individual student, but as part of the instrumental case.

Another limitation was the number of students who participated in the research study. The African-American population at the school was limited to only fifty-six students and having students that were willing to participate in the study decreased the available numbers even more. Having a small sample sized restricted the type of quantitative information I could gather from the results, which made the study qualitative instead of the planned mixed-methods research study. The sample size available was sufficient for the qualitative study but having a larger sample size would have allowed for more perspectives to be considered.

## Chapter 2: Literature Review

### Theoretical Framework

This research study used some of the components of Critical Race Theory in an education space as the theoretical framework. During the 1970s, Critical Race Theory came about from the efforts of legal scholars Alan Freeman and Derrick Bell as a way to develop a better understanding of how racism impacted members of society in the United States (Bell, 1995; DeCuir & Dixson, 2004; Delgado & Stefancic, 2001; Ladson-Billings & Tate, 1995). Critical Race Theory has roots not only within Critical Legal studies, but also political philosophy and feminism (Bell, 1995). To Critical Race theorists, the momentum that was created by the Civil Rights Movement of the 1960s had reached a stalemate and the many advances that took place during the time were being recanted (Delgado & Stefancic, 2001). Critical Race Theory examines how social, economic, and legal differences between races are used to create racial inequalities that benefit the Caucasian population (DeCuir & Dixson, 2004; Delgado & Stefancic, 2001; Ladson-Billings & Tate, 1995).

Race, gender, religious beliefs, sexual orientation, and socio-economic status all work together, as well as individually, against people of color in a society built on racism and discrimination (Chang, 2013; Delgado & Stefancic, 2001). The main notion of Critical Race Theory was the idea that racism is so commonplace in American society that it is often overlooked and ignored as being normal (Bell, 1995; Chang, 2013; Delgado & Stefancic 2001; Ladson-Billings, 2010; Ladson-Billings & Tate, 1995). Race is a tool used by society to establish and enforce white supremacy (Chang, 2013). There are five key components to Critical Race Theory: *White privilege*, *counter storytelling*, *critique of liberalism*, *the prominence of racism*, and *interest of convergence* (DeCuir & Dixson, 2004; Delgado & Stefancic, 2001). In

the following paragraphs, each component will be explained, and the components' influence on the education of African-American students will be discussed. Then I will offer some other research regarding education and Critical Race Theory.

### **Components of Critical Race Theory**

*White privilege* is the notion that white individuals have access to greater opportunities than people of color simply because of their race, not necessarily as the result of their merit (Delgado & Stefancic, 2001; Ladson-Billings, 2010). White privilege within the United States creates a society where white individuals, overall, maintain positions of power and superiority in comparison to other races (Delgado & Stefancic, 2001). The advantages of white privilege are seen within education, career opportunities, and income level (Bell, 1995; Ladson-Billings, 2010). Caucasian students receiving lenient punishments compared to students of color is a prime example of white privilege within education (DeCuir & Dixson, 2004). With school policies, such as dress codes, white privilege is seen when hair styles and clothing styles that are typically worn by African-American students are deemed unprofessional or unkept (DeCuir & Dixson, 2004). Critical Race Theory also looks at the quality of education and opportunities afforded to Caucasian students that are not likely to be provided to African-American students, even within the same school district (Ladson-Billings & Tate, 1995). Of course, some students of color have access to rigorous curriculums and quality education, but the numbers are few and do not represent the percentage of the population composed of African-Americans (DeCuir & Dixson, 2004). Even with integration, policies are still in place that limit the access African-American students have to quality education, allowing Caucasian students to continue to benefit from white privilege (DeCuir & Dixson, 2004).

*Counter-storytelling* is a way for those who are typically demonized by racial stereotypes to articulate their perspectives (DeCuir & Dixon, 2004; Delgado & Stefancic, 2001). Having a counter story demonstrates that there are two sides to a story and believing the ideals that are considered mainstream does not necessarily depict the entire truth (Delgado & Stefancic, 2001). Counter-storytelling is crucial in analyzing why African-American students are often underserved by school systems (Chang, 2013). Counter-storytelling is commonly used in educational research and is seen as a source of “legitimate knowledge” on the unadulterated experiences of African-American students within the educational system (Chang, 2013; DeCuir & Dixon, 2004). It serves as a mechanism to challenge and dismantle the stories entrenched in racism that have been told by the majority in order to further legitimize racist tactics in society and education (Chang, 2013). Authentic experiences and views can come to light for all with the help of counter-storytelling, additionally destroying racism in education (Chang, 2013; DeCuir & Dixon, 2004; Ladson-Billings & Tate, 1995).

*Critique of liberalism* suggests that the typical liberal movements do not have as much of a positive impact on African-Americans as they do white individuals (Delgado & Stefancic, 2001; Ladson-Billings, 2010). The laws and policies created appear to benefit everyone, but when examined closely, the actual impact on African-Americans tends to be minimal (Ladson-Billings, 2010). Advocates of “liberal legal ideology” push three ideas which Critical Race Theorist find fault in: “the neutrality of the law, incremental change, and the notion of colorblindness” (DeCuir & Dixon, 2004). The problem with incremental change is that issues are not corrected in a timely manner to enable the change it is trying to implement (DeCuir & Dixon, 2004). Reversing the devastation caused by racism by hiring a person of color is a step in the right direction but placing the burden on one person to bring about positive change in

diversity is neither likely to happen nor fair (DeCuir & Dixson, 2004). The issue Critical Race Theorists have with the notion of colorblindness and the neutrality of the law is that they do not take into account that racism is still alive and well, and there are still consequences of racism within the school system (DeCuir & Dixson, 2004). Simply ignoring racism and the consequences of racism would do nothing to remedy the damage done by racism throughout history (DeCuir & Dixson, 2004). In addition, colorblindness and neutrality of the law reiterate the notion of white supremacy where Caucasian attributes are the norm by suggesting that understanding the experiences of other races are not necessary since everyone is equal and therefore represented as one (DeCuir & Dixson, 2004). This could potentially be valid if throughout history all voices were taken into consideration, but since that is not the case, it is necessary to add the perspectives of other races, not just considering the majority (DeCuir & Dixson, 2004).

*Prominence of racism.* Racism is so commonplace in the United States that it is accepted as normal and people of color experience it every day (DeCuir & Dixon, 2004; Delgado & Stefancic, 2001). The prominence of racism is seen most evidently within economics as people of color tend to have lower wages, lower employment positions, and limited access to wealth (Delgado & Stefancic, 2001). Within education, racism is seen most often in discipline practices (DeCuir & Dixon, 2004). African-American students are given harsher punishments for the same offenses committed by their Caucasian counterparts (DeCuir & Dixon, 2004). Also, racist acts, such as racial slurs and intimidation, are not punished as harshly when committed by Caucasian students, even though studies have documented the devastating effects such acts have on students of color (DeCuir & Dixon, 2004).

*Interest of convergence* implies that the only way African-Americans will benefit from policy changes is if said policy changes also benefit Caucasian Americans (Bell, 1995). When an injustice mainly impacts African-Americans, little to nothing is done to change the situation until it in some form disrupts the lives of those at the top of the social and economic hierarchy (Chang, 2013; Ladson-Billings, 2010). Though desegregation was thought to benefit African-American students by offering them access to the same tools as Caucasian Americans, the true outcome of desegregation presented more gains for Caucasian Americans (Chang, 2013). The creation of magnet schools and other programs allowed Caucasian Americans the chance to partake in public education, without the disruption of integration (Chang, 2013). Often at prestigious, predominantly Caucasian private schools, African-American students are recruited to improve the athletic program, not to provide them with a quality education (DeCuir & Dixson, 2004). DeCuir and Dixson discussed an instance where an African-American male was stopped in the hallway and asked by a Caucasian student “what do you run the 40-meter dash in?” (DeCuir & Dixson, 2004). The Caucasian student automatically assumed the African-American student attended the prestigious school for athletics, versus academic merit (DeCuir & Dixson, 2004). If it were not for the interest of the school, the recruitment of African-American students would be limited (DeCuir & Dixson, 2004).

### **Other Issues in Education and Critical Race Theory**

In education, Critical Race Theory evaluates how “power and privilege” impact the experiences of children of color within the education system (Chang, 2013). School funding, student tracking, and “high stakes testing”, are all components that are scrutinized within Critical Race Theory, as they present stories of how disproportionate opportunities are often provided to students of color (Chang, 2013).

Funding for schools are based on “property rights”, rather than the rights of the students (Chang, 2013). In using property rights to determine the funding for schools, it ensures that those living in more affluent, predominantly white, neighborhoods will receive more funding since school funds are generated by property taxes (Chang, 2013). Underfunded schools create inequality within the school system, which can impact access to various opportunities, therefore continuing the low-quality “education, employment, and housing cycle” (Chang, 2013). Often, residents in the higher tax communities show resentment for having to pay for public school systems that are utilized by students of color (Ladson-Billings & Tate, 1995). Students today are more segregated than ever, with the help of private schools and magnet schools, which continues the cycle of inequality in education (Ladson-Billings & Tate, 1995).

Inconsistencies are seen not only through funding, but also within the curriculum (Chang, 2013). The voices of African-American students, and other students of color, are needed in order to begin to rectify the wrongs racism has caused within education and to begin the journey towards healing (Dixson & Anderson, 2017). Through the lens of Critical Race Theory, school curricula throughout the United States have not presented the voices of people of color, but rather perpetrate and cultivate the white supremacy narrative seen in a racist society (Chang, 2013). Instances in history that go against depicting people of color as inferior, and thus disputing the claims of the majority, are often left out of the curriculum (Chang, 2013). On the other hand, having a curriculum that is “colorblind”, where all people of color are lumped together, can also cause misconceptions and the creation of additional stereotypes (Chang, 2013).

In summary, tenets from this theory provide background and references for the development of the instruments and data analysis in the research. After data analysis was complete, this theory was used in the interpretation and results. In the next sections, I discuss

the research about African-American's success in mathematics and the concept of Self-efficacy. The chapter concludes with a description of a pilot study used to help guide my work in this study.

### **Overview of What Defines Success**

Webster's dictionary defines success as a "favorable or desired outcome" (Merriam-Webster's collegiate dictionary, 2018). How does this definition of success relate to mathematics education, more specifically, the success of African-American students in mathematics? Within mathematics education, the definition of success varied greatly, depending on the context and demographics of the subjects for which success was defined. African-American students have been institutionalized to believe they were unable to achieve academic success when success was based on the abilities of the majority of the population (Ladson-Billings, 2000).

Of the research that has been conducted related to successful African-American students in mathematics, the examples of success that were found included students taking advanced mathematics courses, students believing they were successful, and students achieving good grades in their mathematics course (Berry, 2008; Ellington & Frederick, 2010; McGee, 2013; Moody, 2004; Noble, 2011; Stinson, 2013). The noted differences concerning the definition of success were subtle and even included using the career choice of an individual to determine if they were successful in mathematics (Noble, 2011).

#### *Advanced mathematics courses*

The most common definition of success for African-American students in mathematics was marked by the ability for students to take advanced mathematics courses (Berry, 2008; Berry, Ellis, & Hughes, 2014; Ellington & Frederick, 2010; Moody, 2004; Noble 2011; Walker,

2006). Taking advanced mathematics courses meant that the student would be enrolled in Algebra I or Geometry while still in middle school, and eventually enroll in a Calculus course, or beyond, by the time they graduated from high school (Berry, 2008; Berry, et al, 2014). Berry, et al. (2014) defined what was considered as taking advanced mathematics courses even further by stating that anytime a student took a mathematics course that was on a higher level than the average students in their grade level, they were taking an advanced mathematics course (Berry, et al., 2014). Moody indicated that to be successful in mathematics, the student should be able to complete a Calculus sequence and take a course beyond Calculus (Moody, 2004).

Being that African-American students were less likely to be encouraged to take an advanced mathematics course by their instructor, often based on teacher biases, they were already considered unsuccessful by default (Berry, 2008; McGee, 2013; Tucker, 2000). Since instructors must advocate for students to take higher level mathematics courses, if there already exists a bias that suggested African-American students were incapable of being successful in mathematics, the likelihood the African-American student would be placed in an advanced class was minimal (Berry, et al., 2014).

#### *Performing well in a mathematics course*

Another common definition of success in mathematics for African-American students that was found in the literature was the ability for African-American students to “do well” in the course (Berry, 2008), which was classified as receiving A’s, and maintaining passing grades (Berry, 2008; Berry, et al., 2014; Tucker, 2000). In one study, Bilal was an eighth-grader who was considered successful in mathematics because he maintained A’s in the course, but as soon as his grade dropped to a C average, his teacher wanted to remove him from the advanced course (Berry, 2008). This act alluded to the hesitation for some teachers to place African-Americans in

higher mathematics courses because they do not believe they would be capable of maintaining passing grades.

*Student perceptions of their mathematical identity and success*

Contrary to popular belief, studies have shown that many African-American students consider themselves successful in mathematics because they believe in their ability to do well in their mathematics courses (Berry, 2008; McGhee, 2013; Moody, 2004; Noble, 2011; Tucker, 2000). Seeing themselves as being successful gave the students the push and desire they needed to continue to try their absolute best in their mathematics courses, regardless of the negative stereotypes they faced or the difficulties in understanding concepts they encountered (Berry, 2008; Moody, 2004; Stinson, 2013). Using their own identity to define what success meant to them may cause more African-American students to view themselves as being successful, which would possibly lead them to strive harder to obtain what the general population would consider success in mathematics (Berry, et al., 2014).

*Being identified as successful by authority figures*

Often, students look to those they consider authority figures to determine how they fit into their surroundings, therefore, being told they were successful by their teachers or parents was another way that African-American students were considered successful in mathematics (Berry, 2008; Berry, et al., 2014; McGee, 2013; Moody, 2004; Stinson, 2013; Tucker, 2000; Walker, 2006). The parents of African-American students were more likely to push for their child to be enrolled in an advanced mathematics course than their teachers, as the parents were invested in the success of their child (Berry, 2008; Moody, 2004; Noble, 2011). Knowing that their parents believed they were successful in mathematics would boost the students' views of their ability to obtain a desirable outcome in an advanced mathematics course. Ashley, who was

a participant in Moody's research, had African-American role models who were mathematics teachers (Moody, 2004). Since she saw individuals who looked like her teaching mathematics, she believed she was also capable of being successful in mathematics (Moody, 2004).

Constantly seeing African-Americans in authority who were regarded as successful in mathematics helped facilitate Ashley's views that African-Americans could be successful in mathematics (Moody, 2004).

#### *Conforming to the majority*

Often, when they were classified as being successful in mathematics, African-American students were said to be "acting white", as though only White individuals were capable of performing well academically (Moody, 2004; Stinson, 2013). Some African-American students had to make the tough decision as to whether to be true to what was perceived as the African-American culture surrounding academics, which included lack of interest and incapability, or to remain true to themselves and their appreciation of academic success (Berry, 2008; McGee, 2013; Moody, 2004; Stinson, 2013).

For example, Ashley suggested that being able to "fit in" (Moody, 2004) with the dominant White culture in academia was a sign of being successful in mathematics, an idea that was essentially echoed in McGee's article (McGee, 2013; Moody, 2004). Ashley implied that what she meant by being able to "fit in" with the dominant White culture was that she did not feel it was necessary to change who she was or how she behaved around different populations in order to be considered successful in mathematics (Moody, 2004). Ashley thought it was commonplace for African-Americans to perform well in academics, therefore her innate behavior and her actions were consistent with what she believed (Moody, 2004).

### *Peers define success*

Even though Berry, Ellis, Hughes, McGee, Moody, and Stinson all suggested that success was determined by an authoritative figure, Ellington, Frederick and Walker implied that peers could also determine whether or not African-American students were successful in mathematics (Ellington & Frederick, 2010; Walker, 2006). Having the ability to help their peers showed that the African-American students were capable of performing well in mathematics, considering they understood the concepts well enough to teach others what they knew (Walker, 2006).

### *Participation in college programs*

Being able to participate in college scholarship programs that were created to support advanced students showed success in mathematics for African-American students as well (Ellington & Frederick, 2010). Depending on their location and school funding, not all African-American students had the ability to participate in college scholarship programs, and therefore missed being classified as successful in mathematics. Stemming from the impacts of segregation and forced desegregation, not all communities had the same opportunities to help foster what was considered as success in mathematics (Berry, 2018).

### *Overcoming negative stereotypes*

In facing a society that has not always been supportive of the educational needs of African-American students, being able to cope with negative stereotypes against African-Americans and still being determined to achieve all set goals implies success in mathematics, and all areas of academia (McGee, 2013). In Moody's research, Ashley indicated that being able to assimilate to White culture was considered to be the determining factor of success, while Sheilah believed that not assimilating to the expected culture was a sign of being successful in

mathematics (Moody, 2004). Even within the same research study, two opposing views of what defined success was discovered.

Having the ability to perform well in a society that was not created to support the achievement of African-American students showed determination and the ability to be successful regardless of the obstacles faced (Moody, 2004). Overcoming obstacles that were intended to be stumbling blocks would show the perseverance needed to achieve success in mathematics. It would be easy to generalize that all African-American students were lazy and unable to perform well in mathematics, all the while ignoring the years of oppression and inequality in the education provided to African-American students compared to other populations. Provided the opportunity, it was shown that African-American students were just as capable of being successful in mathematics as any other demographic (Berry, 2018).

#### *Career goals indicate success*

Noble suggested that to be considered successful in mathematics, the student must consider career goals in the field of mathematics (Noble, 2011). Typically, African-Americans do not pursue careers in mathematics, therefore seeking a career in the mathematics field projects the confidence one has in their ability to do well in mathematics (Noble, 2011).

#### *Standardized tests*

A surprising attribute of success for African-American females in mathematics that Tucker presented was performing well on standardized math assessments (Tucker, 2000). Typically, African-American students did not perform well on standardized tests (Berry, 2008), yet the individuals in Tucker's research noted that to perform well on a standardized test was an indicator of being successful in mathematics (Tucker, 2000). Tucker also discovered that

success in mathematics for African-American females included the “development of quantitative and analytical skills” for whatever mathematics course they were enrolled in (Tucker, 2000).

#### *Alternative to failure*

One way Berry, et al. 2014 defined success for African-American students was as “alternate avenues for failures” which demonstrates the fluidity of the definition of success for African-American students (Berry, et al. 2014). Whereas one may classify success as taking an advanced class, another may simply suggest that success for African-American students would be any time they did not “fail” in mathematics. On the opposite end of the spectrum to define success, Ellington and Frederick suggested an African-American student would be classified as successful in mathematics if they majored in mathematics, or a related field, as an undergraduate or graduate student (Ellington & Frederick, 2010).

#### *Contributions to success for African-Americans in mathematics*

Though literature on what constitutes success in mathematics for African-American students was scarce, the contributions to the success in mathematics for African-American students could be seen throughout. A common aspect that students felt supported their success in mathematics was having the support of family, be it the support of parents, siblings, or other family members (Berry, 2008; Ellington & Frederick, 2010). The support of teachers and peers also helped facilitate success for African-American students (Ellington & Frederick, 2010; Walker, 2006). It was indicated that representation was important for disenfranchised groups, and numerous individuals interviewed said their success in mathematics came from having role models who encouraged them (Berry, 2008; Nobel, 2011; Walker, 2006).

## **Overview of Self-Efficacy**

The definition of self-efficacy used throughout this paper came from Bandura's concept of self-efficacy developed in 1977. Bandura's idea of self-efficacy suggested that self-efficacy encompasses the individual's belief that they could, and would, achieve and surpass the "demands of their academic environment" (Bandura, 1977).

### *Self-efficacy of African-American students*

Self-efficacy was found to be the best determining factor of how well African-Americans would perform in mathematics (Froilanda & Davison, 2016). With positive self-efficacy, regardless of negative comments from teachers or peers, African-American students were able to remain focused and did whatever was necessary to succeed (Fullilove & Treisman, 1990). Having experienced failures early in mathematics education often led to African-Americans having a negative identity of their capabilities to be successful in mathematics (Powell, 1990). As anticipated, when an African-American student had negative self-efficacy, there was a negative impact on their desire to do well in mathematics (Froilanda & Davison, 2016; McClendon and Wigfield, 1998). Overall it appeared that if they did not believe they could do well in the mathematics course, they would not attempt to understand the concepts.

McClendon and Wigfield found that boys had positive self-efficacy more often than girls in mathematics during elementary school (McClendon & Wigfield, 1998). Unfortunately, McClendon and Wigfield found these results from using questionnaires and did not use the actual words of the participants. It could be possible that the girls did not have negative self-efficacy, but the wording of the questionnaire made their opinions of their ability to be successful in mathematics appear negative. In another study, Jones and Ford found that having positive self-efficacy was a determining factor of how well female African-American students performed

in mathematics, but the same was not true for African-American males (Jones & Ford, 2014).

Jones and Ford also used questionnaires to gain a better understanding of the self-efficacy of the African-American students in the study (Jones & Ford, 2014).

#### *Family impact on self-efficacy*

Having a supportive family, be it parents, grandparents, siblings, or other family members, was another factor that impacted the self-efficacy and success of African-American students in mathematics (Terenzini, Rendon, Upcraft, Millar, Allison, Gregg & Jalomo, 1994; Gainor & Lent, 1998; Gutman, 2006). It was found that if their family members were successful in mathematics, the young men in Noble's study also felt they could be successful in mathematics (Noble, 2011). Elijah used the fact that his aunt was a professor at his local university to motivate him to continue to do well in pursuing his degree in mathematics (Noble, 2011). In the African-American community, family could be seen as a representation of oneself, since everyone comes from the same lineage. Seeing someone who looked like them and had many of the same experiences as they did, helped the young men recognize that they were also able to be proficient in mathematics.

#### *Teachers effect on self-efficacy*

From the literature, positive self-efficacy was created when instructors listened to ideas African-American students provided on how to solve the problems presented in the class (Borman & Overman, 2004; Taba & Elkins, 1966). Understanding the cultural context of African-American students also increased their self-efficacy as it showed that the teachers were interested in their lived experiences (Booker & Lim, 2018; Hale-Benson, 1986). When teachers used teaching practices that were not relevant to their students, positive self- efficacy diminished

and the students did not try as hard to do well in the course (Alivernini & Lucidi, 2008; Hallinan, 2011).

Experiencing a validating experience while in the classroom contributes to positive self-efficacy (Gainor & Lent, 1998; Gutman, 2006). When teachers reassured their students that they were smart and capable of doing well in mathematics, their students had positive self-efficacy which caused them to continue to achieve good grades (Noble, 2011). Gutman (2006), saw that when high school teachers used mastery goals instead of grade point averages to determine the understanding of African-American students, the students were more likely to have positive self-efficacy (Gutman, 2006). Showing mastery appeared to be more attainable as it did not require the students to perform well on an assessment. A student could suffer from testing anxiety and not perform well on tests, which would not be a true indicator of their understanding.

Dexter said, "Ms. A. was probably the most influential in helping me realize I was good in math" (Noble, 2011). His positive self-efficacy in mathematics began in elementary school and continued in college where he decided to major in mathematics (Noble, 2011). On the other hand, Barry did not like mathematics while in elementary school, but he saw that he was able to understand complicated concepts quickly and easily (Noble, 2011). It was not until he had a teacher that reinforced the notion that he was indeed good at mathematics that he began to have positive self-efficacy regarding mathematics and wanted to pursue a degree in mathematics (Noble, 2011).

#### *Peer influence on self-efficacy*

Studies have shown that even the school environment could impact positive self-efficacy of African-American students (Diemer et al., 2016; Fenzel & O'Brennan, 2007; Ryan & Patrick, 2001). When other African-American peers encouraged their more successful classmates to

continue to strive towards their goals, it increased the self-efficacy of the more successful classmates (Fullilove & Treisman, 1990; Gainor & Lent, 1998; Jones, Irvin, & Kibe, 2012). Much like having a supportive family, having peers and people in their social network who believed in their ability to succeed led to positive self-efficacy (Jones et al., 2012; Treisman, 1992). Corey stated that having peers who were doing well in the mathematics course increased his self-efficacy because he knew that he had better grades and a better understanding in other areas, and therefore, he could also achieve success in the mathematics class (Noble, 2011). For African-American students, it was found that their ability to solve problems had a significant impact on their self-efficacy when in an environment that was mostly African-American (Schunk et al., 2014). The same was true when African-American students were in a predominantly Caucasian classroom (Schweinle and Mims, 2009). Regardless of the environment the African-American students found themselves in, with the support of peers or teachers, they were able to obtain and maintain positive self-efficacy in mathematics.

### **The Pilot Study**

For my Advanced Qualitative Research course, I conducted a small research study with middle school students. The purpose of the research was to investigate how African-American middle school students, both male and female, viewed mathematics and their schooling experience. The investigation used Critical Race Theory as a theoretical framework and provided some tentative answers to the following questions:

1. How do African-American middle school students feel about their abilities in mathematics?
2. How do interactions with teachers impact African-American middle school students' perspective of math?

3. How does parent involvement impact African-American middle school students' perspective of math?
4. Do peers influence African-American middle school students' perspective of math?

The representation of African-Americans and the lack of studies pertaining to their views was disheartening when trying to find articles to use for the research project. Most literature represented the negative aspects of African-Americans in mathematics or did not use the viewpoints of the participants (Morris, 2007). I was interested in conducting this research to give a voice to individuals who often do not have a voice (Morris, 2007). This research was significant because I wanted to expose the true feelings of a group who was often marginalized and their voice given to them by those who researched their lives but did not actually consider their true thoughts (Morris, 2007). I also wanted to find out if race-relations have improved over the past 30 years in education, and how the stereotypical roles of African-Americans in mathematics have changed. With a focus on inclusion and more professional development geared toward teaching diverse populations (Battey & Franke, 2015), I was curious as to how math teachers currently interact with African-Americans in the classroom. My hope was that the inequality and negative experiences I had were not relevant today.

### *Research design*

A qualitative case study was conducted to gain the perspectives of African-American students in middle school. Since the number of participants in the study was relatively small, only five participants, a qualitative approach was the best method to use. Also, the purpose of the qualitative study was to explore a central phenomenon and ask participants general questions to gather data (Creswell, 2012). The central phenomenon for this research was the experience of middle school, African-American students. The qualitative study allowed the African-American

students to verbally provide details of their views of mathematics and their schooling (Creswell, 2012).

The primary method used to collect data was individual, semi-structured interviews. Semi-structured interviews were used to allow participants to provide open-ended responses to a preselected list of questions I created (Creswell, 2012). Doing this enabled me to guide the participants towards answering the research questions, without limiting their responses. I conducted each interview, and audio recorded the interviews so that they could be transcribed later. I constructed a total of twenty-four questions to ask each participant to get a better understanding of who they were and what they had experienced within a mathematics classroom. Each question was created based on literature found, or missing literature, in relation to African-American students, in addition to incorporating ideas found in the theoretical framework used in the research. Before beginning the interviews, I read the questions to each participant so they would not be surprised by the types of questions asked. Another reason why I read the questions first was to help them feel more comfortable, since they all seemed nervous about being interviewed.

#### *Interview questions*

To protect the identity of the students, I asked each of them to give me a name they wanted me to call that was not their actual name. The following includes a few of the interview questions I asked each participant:

##### *Self - efficacy*

- 1) How do you feel about math?
- 2) How has your feelings about math changed over the years?

- 3) Has your view on your ability to do well in math changed over the years? Please explain.

*Experience with mathematics teacher*

- 4) What did you like about the way your math teacher taught you?
- 5) What practices or methods (approaches) would you like for your math teacher to use?
- 6) What did you like, or not like, about your interactions with your math teacher?

*Family Involvement*

- 7) Do you feel as if your parents or guardians are invested in your schooling? For example, do they go to parent-teacher meetings, ask you about what you are covering in school, etc.?
- 8) Academically, do you have the support of other family members?

*Peer Influence*

- 9) Have you ever answered a question incorrectly to make your classmates laugh?
- 10) Has your teacher ever asked you for the answer during class and you pretended to not know the answer, even though you actually did?
- 11) Do your friends encourage or applaud your success in mathematics?

*Participant selection*

Purposeful homogeneous selection was done to ensure the participants would be in the demographics of interest, but to still allow for variation in responses. In purposeful homogeneous sampling, preselected criteria relevant to specific research questions were the basis from which participants were selected (Creswell, 2012). I selected middle school aged students because middle school is where many African-American students begin to become disinterested

in mathematics (Martin, 2000). The five participants chose their own pseudonyms: Mora, Shae, Wig, G.O.A.T., and Pooh.

### *Coding*

For data analysis, I used in-vivo coding. With in-vivo coding, codes emerged from the data collected in the interviews (Miles, Huberman, & Saldaña, 2014). My goal for the research study was to capture the views of African-American students, and in-vivo coding allowed me to directly represent the voices of the participants. I completed the first phase of coding after the final transcription, and then using the codes that emerged, I completed the second phase of coding. In the first phase of coding, I noticed a trend of positive perceptions and feelings towards mathematics, teachers, and experiences. Few of the participants had anything negative to say regarding mathematics, their interactions with others, or their experiences in school. From the second phase of coding I identified recurring themes. The themes discovered were positive self-efficacy, positive teacher relationships, supportive teachers, positive peer interactions, and family support.

*Results*

Research Question #1: How do African-American middle school students feel about their abilities in mathematics?

**Table 2.1**

*Pilot Study Research Question #1*

<b>Code</b>	<b>Supporting Quote</b>	<b>Participant</b>	<b>Theme</b>
Easy	" it's pretty easy and I am better than most of the students in my class in math" "Usually I don't need help"	GOAT, Wig	Math is easy
Getting harder	"At first math was easy at the beginning... but now... it's like... it's getting more harder... for me to like learn" "elementary school math was easier than middle school math"	Pooh, Mora, Shae	Middle school math is a challenge
Like it	"I like doing it" "it is fun"	Mora	Like math overall
Confidence	" I feel more..." "It hasn't changed at all because I've loved math ever since I started learning 1 + 1 and 2+2"	Mora, GOAT	More confident in ability to be successful in a math class
Study	"study" "studying is important so you can move on to the next grade"	Mora, Wig, Pooh	Need to study

Research Question #2: How do interactions with teachers impact African-American middle school students' perspective of math?

**Table 2.2**

*Pilot Study Research Question #2*

<b>Code</b>	<b>Supporting Quote</b>	<b>Participant</b>	<b>Theme</b>
Best	"One of the best math teachers"	GOAT	Race doesn't matter
Group work	"We worked in groups"	Mora, GOAT, Shae, Pooh	Community learning
Website	"It is a really good website"	Shae	Technology important when used correctly/methodically
Easy	"give us easy problems when we don't need those"	Mora	Want to be challenged"
Blocks / worksheets	" I would like for my new teacher to use like... for it to be like... give us like... umm... material to work with... like... like... the blocks.... " "a lot (of worksheets)"	Mora, Wig	Hands on material
Individual	" we didn't necessarily work in groups... we.... We had individual... and sometimes we played games dealing with math"	Wig	Individual learning at times can help with understanding
Break it down	"she would break it down a lot" "like giving us good information... how to ummm... work out our problem"	Wig, Pooh	Speaking to the students on their level to facilitate understanding
Difficult problems	"like if it was a difficult hard problem, we would work it out on the board"	Mora	Work through difficult problems as a class
Encouragement	" she actually never gave up on anybody no matter what"	GOAT	Encourage the students to succeed

Research Question #3: How does parent involvement impact African-American middle school students' perspective of math?

**Table 2.3**

*Pilot Study Research Question #3*

Code	Supporting Quote	Participants	Theme
Supportive	"supportive enough" "attend conferences"	Mora, Shae, Wig, Pooh, GOAT	Parents make time for children's education
Other family members	"Brother", "Cousins", "Sister", "aunt"	Mora, Shae, Wig, Pooh, Goat	Other family member help when parents are busy

Research Question #4: Do peers influence African-American middle school students' perspective of math?

**Table 2.4**

*Pilot Study Research Question #4*

Code	Supporting Quote	Participant	Theme
Better than peers	"I think I am better because sometimes I have to help them" "I say I am a little smarter" "in my class there were a lot of students who were below my level"	Mora, Wig, GOAT, Shae	Smarter than peers
Shy	"I was just shy because it was my first time going to middle school"	Mora	Being comfortable around peers impact responses to teacher
Give answers	"No... I never did that" "No"	Wig, Mora, Shae, GOAT	Okay with demonstrating their knowledge in front of peers
Joke around	"make them laugh"	Pooh	When not confident in understanding, more likely to want to make peers laugh to distract

### *Reliability and validity*

The data were validated by member checking. I had each participant read the transcript from their interview to make sure they agreed with, and could verify, what was said. Also, after I transcribed the interviews, I listened to the audio recording three times while reading the transcript to confirm the translation was correct. There were no ethical issues that came from this research and no participants were harmed emotionally or physically.

### *Discussion*

“How do African-American middle school students feel about their abilities in mathematics?” was the first research question to be answered from the study. As a whole, the participants had positive views of their abilities to be successful in mathematics. Both GOAT and Wig indicated that they thought middle school mathematics was easy and they usually did not need help. Even though their perspectives were positive, Pooh, Mora, and Shae all suggested that middle school math was more challenging than what they experienced in elementary school. To overcome those challenges, Mora, Wig, and Pooh said studying was important to help them understand concepts better. Mora said she was more confident in her ability to do well in mathematics in middle school, even though it is more challenging. All other participants said they felt about the same in their abilities to be successful in mathematics.

The second research question “How do interactions with teachers impact African-American middle school students' perspective of math?” had a similar positive response as the first research question. GOAT said the race of the instructor did not matter. Mora, GOAT, Pooh, and Shae believed instructors allowing them to work in groups helped facilitate their success in mathematics, however, Wig said he preferred to work by himself to increase his understanding. GOAT suggested having an instructor that was encouraging and never gave up

on their students was an important component of his success. Wig and Pooh indicated that having an instructor speaking to the students on their level to facilitate understanding was beneficial to their success.

All participants said they believed their parents supported them and made time for their education, which answered the third research question “How does parent involvement impact African-American middle school students' perspective of math?” Most parents showed their support for the participants by attending parent-teacher conferences and helping with homework when they could.

“Do peers influence African-American middle school students' perspective of math?” was the final research question proposed. Wig, Mora, GOAT, and Shae said they were just as good as their peers in mathematics, if not better, and were not afraid to show their friends that they knew the answers in class. Pooh, on the other hand, did not think he was better than his peers in mathematics, and would try to make them laugh in order to deflect from not knowing the answers.

#### *Limitations and delimitations*

A significant limitation I encountered in the study was the lack of details some participants gave. Given their ages, this was understandable; however, with limited details, I did not have as much information to guide my findings as I would have liked. Additionally, I found that I did not always ask additional follow-up questions to encourage the participants to provide more details, and this will be addressed in my dissertation study. The lack of literature specific to African-American females in mathematics proved to be a limitation as well. As the researcher, I was limited with whom I could ask to participate in my study. I also restricted the grade level of the participants prior to beginning the study when I realized I had limited

resources available in a short amount of time.

*Connections to dissertation study*

The results from the pilot study created more questions as to why a change takes place between middle school and high school where African-American students no longer have positive self-efficacy in their ability to be successful in mathematics, as suggested by the literature (Martin, 2000). For my dissertation, my advisor and I agreed that it would be important to study the personal and environmental factors that could potentially impact the perspectives of African-American students. Since I am teaching at a school for talented high school students, I chose to focus on that population of African-American students that are successful in mathematics.

### **Chapter 3: Methods**

Studies have shown that when socio-economic status and gender are consistent between African-American students and others, the accomplishments of African-American students are still not equivalent to the accomplishments of the Caucasian students (Ladson-Billings & Tate, 1995). These findings, as well as additional findings that are connected to the Critical Race Theory theoretical framework (DeCuir & Dixson, 2004; Delgado & Stefancic, 2001; Ladson-Billings & Tate, 1995), were used to create the following research questions:

#### **Research Questions**

1. What personal and environmental factors influence the success of African-American high school students in mathematics?
  - a. What impact does parental interaction have on the success of African-American students in mathematics?
  - b. What impact does family interaction, particularly extended family interaction, have on the success of African-American students in mathematics?
  - c. How do interactions with instructors impact the success of African-American students in mathematics?
  - d. What role does peer interaction play on the success of African-American students in mathematics?
  - e. How does socio-economic status influence African-American students being successful in mathematics?
  - f. What other environment factors may affect African-American high school students' success in mathematics?
2. How is self-efficacy related to success and the environmental factors mentioned

previously?

## **Research Design**

The research design used for my work was an instrumental case study to gain the perspectives of African-American students in high school that are classified as successful in mathematics. The purpose of the qualitative instrumental case study was to understand the history and experiences of the students in detail, as well as to explore a central phenomenon of being African-American and successful in mathematics (Creswell, 2012). The case for this research was a set of African-American high school students who are enrolled at a gifted high school, and who maintain an A or B in their math course. This qualitative instrumental case study allowed the African-American students to verbally provide details of their views of mathematics and their schooling experiences, both inside and outside of the classroom, as it relates to their success and self-efficacy in mathematics (Creswell, 2012). It provided the “student voice” that often is missed in research of this kind.

To conduct this research, I used three data resources: a survey, interviews, and narratives. In order to discuss the case, it was imperative that I collect data in different ways. The first way I collected data was from the survey which provided one view of the case of successful African-American students. With the survey, I gathered information about interactions between the students and environmental factors, as well as their perceived self-efficacy as it related to each factor. Being that the entire population of successful African-American students was only fifty-six, having twenty-six students complete the survey provided representation for approximately forty-six percent of the case. The survey covered a wide spectrum of the case from which I then decided to use another perspective in order to dive deeper into the case. From the participants who completed the survey, I selected nine students to

interview. These nine students represented all possible scenarios represented in the population in terms of their living environment, house ownership, and parental education. From the interview, I selected five participants to write a detailed narrative about their experiences and perspectives of mathematics as African-American high school students. The participants that were selected to have narratives written about their experiences were selected because they represented unique experiences, whether it was negative interactions with their peers, or they had a close relationship with their family. The narratives allowed me to become fully immersed in the lives of these individuals and their experiences with their family, teachers, peers, and within themselves. More details about each of the data resources will be described later.

As mentioned previously, this study used an instrumental case study design to gain a better understanding of the set of African-American students, deemed successful in mathematics, who attend a gifted high school in the southeastern part of the United States. With instrumental case studies, the focus of the research is the phenomenon, rather than the participants, in order to gain insight as to why, or how, a phenomenon takes place (Johnson & Christensen, 2000; Mills, A. J., Durepos, G. & Wiebe, E., 2010; Stake, 2005). An instrumental case study allows the researcher to obtain more insight on a phenomenon, as well as create conjectures as to why a phenomenon occurs, better than other types of case studies since the focus is on the issue being studied (Mills, et al., 2010; Stake, 2005). According to Yin (2014), an instrumental case study allows the researcher to examine a phenomenon as it occurs in “real life”. In other words, an instrumental case study allows the researcher to obtain a first-person account of the phenomenon that occurs, through thorough exploration, which can lead to creating a “theoretical understanding” of a concern (Stake, 2005; Yin, 2014). Creswell (2008) emphasized that an instrumental case study allows for the comprehensive examination of an anomaly within a

“bounded system”. In this study, the case of the set of African-American students who are successful in math is bound by time (a two-year program) and location (public magnet school in the same region of the United States). It is suggested that case studies use various sources of evidence to support the findings, which include, but are not limited to questionnaires and interviews, both of which were used for this study (Creswell, 2008).

### **Context**

The participants in this study all attend a residential high school with a student population that is deemed academically gifted. The students attend the school during their junior and senior year, taking a broad range of classes that are also found in a traditional high school. The high school uses a modeling focused mathematics curriculum that includes a wide variety of mathematics courses offered, ranging from Precalculus to Combinatorics. Class sizes vary from 15 to 25 students and students are enrolled in a mathematics course every term while they are at the school. There are over six hundred students at the high school, with only eight percent being African-American. There are twenty-nine African-American students who identify as male and twenty-seven African-American students who identify as female.

All faculty members that teach at the school either have a masters or doctoral degree in their discipline. Of the almost ninety faculty members, eight are African-American.

### **Overview of Methods**

The relationship among the personal factor of self-efficacy, environmental characteristics, and success of African-American students in mathematics was first collected by using a survey consisting of a set of questions whose responses were received on a Likert scale. The survey was designed to understand how personal and environmental factors relate to the success and self-perceived self-efficacy of African-American students in mathematics.

Qualitative data was also collected using semi-structured interviews to allow me to obtain in-depth analysis, which was needed to understand the experiences of participants in detail (Creswell, 2012). A total of nine participants, out of the twenty-six students that completed the survey, were interviewed (Creswell, 2012).

### **Human Subjects**

To begin the research, I first received permission from the administration of the school to speak with their students. I emailed all students who identified as African-American, using the database provided by the school. I emailed parental/guardian permission forms by way of Google Forms to the official email addresses of the parents/guardians of the students who were interested in participating, which their parents/guardians had to fill out by using the email address I was provided, granting them permission to participate in the study. For each student who had permission and wanted to be included in the study, an online consent form was emailed for them to fill out through Google Forms before they could complete the survey. After they completed the online consent form, the student participants completed the survey which asked about their self-efficacy and perceptions of mathematics. Additionally, those who participated in the interviews were asked to sign an informed consent before the interviews. IRB approval from North Carolina State University was granted prior to obtaining informed consent from the students and parents, the administration of the survey, and conducting the interviews.

### **Survey Participants**

All participants in this study were students who identified as African-American and were enrolled in a state-supported, public residential high school for academically gifted students located in the southeastern region of the United States of America. Since the entire population of African-American students who were considered successful in mathematics was relatively small,

I sent an email to all student who identified as African-American according to the school database. All of the students at the school are considered successful in mathematics because they are all taking a math class that is at least one level above their peers in the same grade, therefore a question in the survey asks about their current grade in the course to make sure they were successful according to the definition used for this study and fell within the demographics of interest. (Creswell, 2012). All participants had similar experiences and backgrounds being that they were all African-American students in an advanced mathematics class and attended a high school with an accelerated modeling mathematics program. All participants were also from the same region of the United States of America. The survey consisted of two parts: Part A, which contained personal questions about the participants, and Part B, with Likert scale items, described below.

### **Details about Part A of the Survey**

The purpose of Part A of the survey was to gain personal information about the participants. The survey questions asked the participants about their race, to make sure they identified as African-American, whether they completed Math I in the eighth grade, and their grade in their current mathematics course. Questions pertaining to socio-economic status are more sensitive and it is unethical to ask questions about them directly, therefore, I used proxies to obtain information about socio-economic status.

As a proxy, I asked the question “Do your parents own the home you stay in?” to approximate the socio-economic status of the participants. If the participants said their parents own the home they stay in, I coded the response as a 1, and as a 0 if they did not. The socio-economic status will be placed in either middle-class and above (group 1) or working-class (group 2) (Coffee, et. al, 2013). The location of the living environment is also an indicator of

socio-economic status; therefore, I also asked the participants to indicate whether they stayed in an urban, rural, or suburban environment, using the codes 0, 1, and 2 respectively (Coffee, et. al, 2013). Living in a suburban environment is considered being middle-class and above, while living in an urban environment, with the exception of most downtown living, is thought of as being working-class (Coffee, et. al, 2013). Another proxy to help determine socio-economic status was “If applicable, what is the highest level of education obtained by your Mom?” as well as, “If applicable, what is the highest level of education obtained by your Dad?”, as socio-economic status is directly linked to the highest level of education obtained (Coffee, et. al, 2013). The responses for education level were coded as a 0 for high school and below, and a 1 for a two-year community college and above. Those who obtain more than a high school diploma typically fall within, or above, the middle-class group (Coffee, et. al, 2013). Using the values given for homeownership, living environment, and education level of parents, I took the average to determine if the participant was considered middle class or not. A participant with an average score greater than or equal to .67 was classified as middle class, and a participant with an average score below .67 was classified as working class.

### **Part B of the Survey: Likert Scale Data Collection**

All Likert scale data was collected from an electronic questionnaire created in Google Forms. The questions that were used in the Google Forms can be found in Appendix A. Likert scales were created as a valid and scientific way to “measure” qualitative attributes, such as attitude and opinions (Joshi, Kale, Chandel, & Pal, 2015). With a Likert scale, participants are provided with either “real or hypothetical situations” the researcher is interested in studying and asked to indicate how much they agree with the given statements (Joshi, et al., 2015). The researcher then must analyze the statements together in order to determine how the participants

feel about the subject being studied (Joshi, et al., 2015; Sullivan & Artino, 2013). Likert scales can be symmetric, where the middle position represents a neutral opinion and the same level of extremeness appear on both sides, or asymmetric, where the scale does not have the same extremes on each side (Joshi, et al., 2015). A symmetric Likert scale allows for more options for selection than an asymmetric Likert scale (Joshi, et al., 2015). Typically, the scale used varies from seven or ten points, but it could also include a five-point scale (Joshi, et al., 2015; Sullivan & Artino, 2013). It is noted that the more points available on the scale, the more likely the participant is able to select the choice that most closely reflects their true opinion (Joshi, et al., 2015). For this study, I used Likert scales with 5 points.

I created the questions for the Likert Scale based on the information I gathered from personal experience, the pilot study, and the literature as it pertains to African-American students and their self-efficacy in mathematics, as well as environmental factors that impact their success. For example, Question 29 states “My parent(s) help me be successful in mathematics (helping with homework, giving encouragement, etc.)”. I created this question based on my personal experience of having supportive parents that helped with me with my math homework and encouraged me to strive for excellence. I also used the literature from Terenzini et.al, 1994, Gainor & Lent, 1998, and Gutman, 2006 that suggests having a supportive family impacts the self-efficacy and success of African-American students in mathematics. This survey question helped answer research question 1A that asks, “What impact does parental interaction have on the success of African-American students in mathematics?”

Question 38 states “A past instructor helped me be successful in mathematics” while Question 39 states “My present instructor helped me be successful in mathematics”. These questions were created based on the literature from Ellington & Frederick, 2010, as well as

Walker, 2006 that says the support of teachers and peers helped facilitate success for African-American students in mathematics. I also used information I gained from the pilot study, as well as my personal experience with supportive teachers to create questions 38 and 39. Questions 38 and 39 helped to answer research question 1C that asked, “How do interactions with instructors impact the success of African-American students in mathematics?”

Family interactions, instructor interactions, and peer interactions were all used as additional environmental factors to determine if they had an impact on the success and/or self-efficacy of the students. Knowing that all of the students who participated in the survey and interview were classified as successful, the intention of the questions were to determine if there were any similar or varying factors that contributed to the success of the students, and how those impacted their self-efficacy. The participants were asked how much they agreed, or disagreed, with statements made regarding their interactions with their family, instructors, and peers. Similar to the personal questions, the responses were coded on a scale from 1 to 5. The average value for each characteristic, taken from the questions, was analyzed with respect to the participants' success and self-efficacy in mathematics.

The interview participants were individuals that took the survey and disclosed that they were doing well in their mathematics course, meaning they had an A or B. They were all African-American high school students who were enrolled in an advanced mathematics course. Everyone in the study was categorized as successful, therefore environmental and personal factors of interest included self-efficacy, parental interactions, instructor interactions, and peer interactions. Each of these factors were considered independently, but also compared to each other to determine what they had in common, if anything.

## **Analysis**

The data from the survey was entered into a spreadsheet using Google Sheets. Using the spreadsheet, I examined what percentage of the participants disagreed, agreed, or were neutral about each question that used the Likert Scale. For simplicity reasons, I combined the values of those that agreed and strongly agreed together, and also the values of those that disagreed and strongly disagreed together. The responses that were neutral remained to themselves.

One of the factors in the study was the self-perceived self-efficacy of the African-American students in mathematics. Using the questionnaire, I tried to determine if the students felt that they had positive, negative, or neutral self-efficacy in mathematics. This was done by finding an average value for the questions that asked about self-efficacy specifically (Punch, 2007). The exact process for this is explained in more details in the next paragraph. As previously mentioned, self-efficacy can be impacted by environmental factors, therefore, I examined how each student viewed the impact on their success by said environmental factors. It was also necessary to identify how environmental factors directly impacted success in mathematics for African-American students; therefore, a relationship between each of the following and success was examined: socio-economic status, family interactions, instructor interactions, and peer interactions.

The analysis continued as separate pages were created on a Google Sheets document to separate each factor and make analysis easier. As mentioned previously, a number was given for the response to each question of the questionnaire provided by participants (Punch, 2007). For each factor, strongly agree was given a value of 5, agree was given a value of 4, all the way down to strongly disagree having a value of 1. For example the question “My present math instructor helped me feel as though I could do well in math” implicates a positive impact on the

student, and therefore, the response provided would impact the average score that corresponds to whether teachers had a positive impact on the student's self-efficacy and success. A similar method was applied for factors that could have a negative impact, only with the value of 5 changed to 1, 4 to 2, 2 to 4, and 1 to 5 to accommodate the negative voice of the question. At the end of the data summarization, each participant had one final value, an average, to show their representation for each factor (Punch, 2007). The average of the factors was calculated by adding the individual values for each factor and dividing by the total number of questions related to the factor (Punch, 2007). The factor scores calculated at this step was used for the analyses that followed (Punch, 2007). For each factor, if the average value was greater than or equal to 3.5, it indicated the factor had an impact, whether it was negative or positive, on the student. If the average value was greater than 2.5 and less than 3.5, the factor was neutral, meaning it could potentially have an impact, but there was not enough information to make an affirmative decision. For average values less than or equal to 2.5, the factor was concluded to have no impact on the student.

### **Interview Data Collection**

From the twenty-six participants who completed the survey, I purposefully selected nine of them to participate in the interviews. The participants selected for the interview include both male and female participants, as well as individuals from each socio-economic status that was represented. Using the responses to the personal information portion of the survey, I included students who have parents that obtained varying levels of education as well. There was one student who participated in the survey portion of the study who came from a single-parent household and her parents did not own a home, but she was unable to participate in the interview portion of the study as the result of having to work.

Qualitative data was collected by conducting semi-structured interviews. Semi-structured interviews allow the participants to give open-ended responses to a preselected list of questions (Creswell, 2012). At the start of each interview, I allowed the participants to select their own pseudonym. Each semi-structured interview was audio and video recorded. Recording the interviews allowed for transcribing during the data processing phase, which gave an accurate record of what the participants said. The interview protocol used for the study can be found in Appendix B at the end of the document. The questions used in the interview protocol were generated from the literature found regarding self-efficacy for African-American students, as well as the various factors that impact their success in mathematics.

During each interview, I took notes of non-verbal cues, such as hand gestures, frowns, smiles, and other movements/expressions. Observing gestures during the interview helped with inferring emotions and reactions while analyzing the data later. There was one interview per participant, each lasting roughly an hour to an hour and a half. The interviews asked probing questions regarding the personal identification of the student's own self-efficacy, how their parents and other family members, peers, and instructors impacted their success, and possibly their self-efficacy, as African-American students in mathematics.

### **Interview Data Analysis**

For data analysis, I transcribed each interview and then coded each response by using in-vivo coding where codes emerge from the data collected in the interviews (Miles, Huberman, & Saldaña, 2014). This allowed me to capture the perspectives of the interviewed participants and directly represent their views. While coding, I was mindful of the components of Critical Race Theory as it relates to education, in particular, counter storytelling, the prominence of racism, and white privilege. Being that I used the voices of the participants, counter storytelling was a

fundamental part of the data analysis. I did not change the words of the participants but allowed their views to come forward in the codes. The prominence of racism was seen through the data analysis when Randy, Trey, and Tam mentioned situations when they felt their peers or teachers treated them differently because of their race. There was a situation in particular when Tam believed her peers were making racist comments, but the teacher did not chastise them in any form. The teacher was so used to hearing such utterance that it did not occur to her that what the other student was saying was offensive. While coding, white privilege also came to mind when it was seen that the African-American students were treated differently than their white counterpart and it was assumed that the white students had a better understanding of concepts. Randy recalled a situation when his peers asked him for help, but then turned to his white classmate with the same question because they did not believe Randy truly knew the answer. It was assumed the white classmate had a better understanding of the concepts purely because they were white.

I put the entire transcription into a table in Google Docs, and I used the table to determine which codes emerged from each section of the transcription. After I finished going through the transcripts and creating the codes, I went back to the beginning of the transcripts to make sure the codes were consistent throughout the interview (Creswell, 2008). When I had questions about the codes that emerged, I reached out to my advisor for help. I studied the codes and identified the codes that appeared to be similar, and the similar codes were then combined into themes (Creswell, 2008). I identified emerging themes regarding how self-efficacy and environmental factors impacted their success in mathematics, as well as how the same environmental factors potentially impacted their self-efficacy. I tried to determine how the

themes differed between male and female interview participants, and how themes differed within the male and female interview participants but did not notice any commonalities.

### **Conducting Research During a Pandemic**

Having to conduct research during Covid-19 proved to come with many challenges, but not all were negative. Since we were no longer able to meet in person, having the flexibility to schedule interviews outside of the normal business hours was the only effect of Covid-19 that could be considered “positive”.

The biggest challenge created by Covid-19 was trying to overcome technology issues that came up during the interviews. The interviews were conducted through Zoom, but for some students, their microphones would not work properly, or they had a slow internet connection. Even if their microphones were working properly, having a slow internet connection still caused their audio to become distorted and very difficult to understand. There were a few times that participants forgot to plug in their laptop and their computer died in the middle of the interview, but this obstacle was not difficult to overcome. Another stumbling block from virtual interviews was dealing with background noises if the participant did not have noise-cancelling headphones. Between the background noise and distorted voices, portions of the interviews were difficult to transcribe, which may have resulted in important information being lost. Accidentally talking over each other was also an issue since there was always a delay between when someone spoke and when the audio was heard by the other person.

To make up for lost revenue, some students had to work over the summer when they had not initially planned to do so. This made scheduling interviews impossible for some, even with the flexibility of meeting online. Having to revise the IRB because I could no longer print hard copies of the permission forms and having to make digital copies of everything was a nuisance,

but easily managed. I thought Covid-19 would impact how the participants felt about their interactions with their teachers and peers, but that did not seem to be the case. None of the interview participants mentioned that their interactions with their peers or teachers were hindered in any way by Covid-19.

### **Survey and Interview Connection**

The survey and interview were vital in understanding the factors that impact the success, and eventually the self-efficacy, of African-American students in mathematics. It has been noted previously that more than one source of information is needed in an instrumental case study to get an understanding of the phenomenon (Creswell, 2008). The survey allowed me to gain knowledge of the backgrounds of the participants, including their socio-economic status and the education level obtained by their parents. The interviews allowed me to dive deep into the personal and environmental factors that influence the phenomenon of being African-American and classified as successful in mathematics.

### **Summary: Overview of Study**

The following table shows the research questions, as well as sub-questions, and how data for each question was collected and analyzed. The table also shows the timeline as to when each process took place. The first research question, along with the five sub-questions, was answered by the survey that uses a Likert scale to determine how African-American students feel about the impact of various factors on their success in mathematics in conjunction with the instrumental case study by the way of interviews. The interviews were analyzed by in-vivo coding to determine the common themes that emerged from the interviews.

**Table 3.1**

*Data Collection and Analysis Overview*

Research Question	Data Collection	Data Analysis	Timeline
<p>What environmental factors influence the success of African-American high school students in mathematics?</p> <ul style="list-style-type: none"> <li>➤ What impact does family interaction, in particular parental interaction, have on the success of African-American students in mathematics?</li> <li>➤ How do interactions with instructors impact the success of African-American students in mathematics?</li> <li>➤ What role does peer interaction play on the success of African-American students in mathematics?</li> <li>➤ How does socioeconomic status influence African-American students being successful in mathematics?</li> <li>➤ What other environment factors may affect African-American high school students' success in mathematics?</li> </ul>	<ul style="list-style-type: none"> <li>❖ Survey               <ul style="list-style-type: none"> <li>➤ Likert scale</li> </ul> </li> <li>❖ Case study               <ul style="list-style-type: none"> <li>➤ Interviews</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>❖ Determine if there is a connection between self-efficacy and the environmental characteristics, and how success is impacted by self-efficacy and environmental factors by using the survey.</li> <li>❖ In-vivo coding               <ul style="list-style-type: none"> <li>➤ Themes emerge from codes found from what the interview participants say</li> <li>➤ Form of inductive coding                   <ul style="list-style-type: none"> <li>■ Transcribe the interviews</li> <li>■ Highlight words or phrases that keep reappearing (at least half of the interview participants mention the word or phrase). These will be the codes used                       <ul style="list-style-type: none"> <li>● Create a table that shows the codes and supporting quotes for easy analysis</li> </ul> </li> </ul> </li> <li>➤ Use the codes to formulate emerging themes</li> </ul> </li> </ul>	<p>Summer 2020</p>

**Table 3.1**

*Data Collection and Analysis Overview (continued)*

<b>Research Question</b>	<b>Data Collection</b>	<b>Data Analysis</b>	<b>Timeline</b>
How is self-efficacy related to success and the environmental factors mentioned previously?	❖ Case study ➤ Interviews	❖ Using the themes created from the interview, determine how self-efficacy relates to success for the students and how the environmental factors impact self-efficacy in math.	Summer 2020

**Reliability and Trustworthiness**

The plan was to have the interview participants review the transcript of their interviews to create reliability and trustworthiness of the themes that emerged, but due to Covid-19 and drastic changes in schedules, this was not possible. Instead, I listened to the audio recordings of the interviews two or more times in order to make sure I had the most accurate transcription possible. After reviewing the transcripts, if I had a question about something the interviewee stated, I sent them an email for clarification.

**Ethical Considerations**

When speaking with interview participants regarding their experiences in a mathematics classroom and other settings, it is possible to recall negative experiences, which may have a negative impact on their emotions. I provided the interview participants with an interview protocol prior to our interview in order to give them the option of not answering questions that could potentially have negative repercussions for them. No negative physical effects resulted from participating in the research study.

## **Chapter 4: Descriptive Statistics from Survey**

In this brief chapter, I present an overview of the compilation of the data from the survey that provided information about all the participants in the study, both those that were interviewed and those that were not. I note that these are primarily descriptive statistics. I will summarize results after each topic section that covers parent, teacher, and peer interactions in addition to self-efficacy.

After analyzing the data, it was found that there was very little difference between the responses for the male and female participants in general. Therefore, each question does not go into detail as to the responses of each gender, unless there was a distinct contrast between the two.

### **Participant Selection**

Of the fifty-six African-American students that attended the school of interest, twenty-six were willing and able to take the survey created to help gather information regarding their experiences in mathematics. Two factors that were looked at to determine if students were successful in mathematics were if they took Math I during their 8th grade year or earlier, and if they had an A or B in their current math course.

Twenty-three out of the twenty-six students took Math I (or Algebra 1) while in the 8th grade, or before. The three students that did not take Math I while in the 8th grade or prior were all female students. All three students who did not take Math I in 8th grade were still on track to take Calculus while in high school, and therefore were still considered successful in mathematics. Twenty-four out of the twenty-six students had either an A or B in their current math course. The two students who did not have an A or B were included in this chapter but

were omitted from the interview portion of the study since they did not have the grades required to participate.

**Socio-economic Status**

One research study found that where people lived, their highest education level obtained, and whether they owned their home were indicators of their socio-economic status (Coffee, et al., 2013). The survey asked questions regarding the living environment, home ownership, and parental education of the participants to gain a better understanding of what the socio-economic status of the participants could potentially be. Asking direct questions about the socio-economic statuses of the students did not seem appropriate and might not be ethical, so proxies of home ownership, living environment and parental education were used to consider socio-economic status.

**Table 4.1**

*Socio-economic status summary table*

<b>Home Ownership</b>	<ul style="list-style-type: none"> <li>● 24 out of 26 students have parents who own the home they live in</li> </ul>
<b>Living Environment</b>	<ul style="list-style-type: none"> <li>● 0 students live in an urban environment</li> <li>● 9 students live in a rural area (self-identified)</li> <li>● 17 students live in the suburbs (self-identified)</li> </ul>
<b>Parents' Education</b>	<ul style="list-style-type: none"> <li>● 1 student had both parents who earned a master's degree or higher</li> <li>● 10 moms earned a master's degree or higher</li> <li>● 13 moms earned a 2- or 4-year college / university degree</li> <li>● 3 moms earned a high school diploma / GED</li> <li>● 10 dads earned a master's degree of higher</li> <li>● 10 dads earned a 2- or 4-year college / university degree</li> <li>● 6 dads earned a high school diploma / GED</li> </ul>

The data in Table 4.1 is self-explanatory. I mention here some of the relationships between the three characteristics that occurred.

- Of the two students, one male and one female, whose parents do not own their home, both lived in a rural area. The parents of the male student both had at least a 2-year degree, and while the parents of the female student were the only case where both parents only obtained a high school diploma or GED.
- In all other cases, if one parent had their GED or high school diploma, the other parent had either a 2- or 4-year degree, or master's degree or higher.

Since the survey did not directly ask the socio-economic status of each family represented, with the knowledge obtained from other research, a reliable approximation of socio-economic status was inferred. Using the proxies, it was found that all the students who participated in the survey, with the exception of one, could possibly be considered middle-class or higher (Coffee et al, 2013). Of course, numerous other factors ultimately determine socio-economic status, such as the cost of living in their area and whether the income their parents earned matched the projected income for the education level obtained.

### **Self-efficacy Questions**

As mentioned previously, self-efficacy is how the students viewed their ability to do well in a mathematics course and how successful they believed they were in mathematics. Previous research suggested that self-efficacy impacts the success of African-American students in mathematics (Froilanda & Davison, 2016). The following table shows the questions asked in the survey to gather more information about how the students viewed their abilities in math, combining the self-efficacy and success constructs. After the table are general statements that summarize the most significant findings from the survey questions.

**Table 4.2***Self-efficacy summary table*

<b>Question</b>	<b>Female / Male</b>	<b>Number that strongly agree/agree</b>	<b>Number that were neutral</b>	<b>Number that disagree/strongly disagree</b>
10. I believe I am successful in mathematics.	Female	13	2	4
	Male	4	3	0
11. I can get good grades in a math course.	Female	14	4	1
	Male	6	0	1
12. I am confident in myself when I give my answer to a math problem.	Female	6	7	6
	Male	4	1	2
13. I believe I am able to learn and understand any form of mathematics.	Female	12	2	5
	Male	6	0	1
14. I am just as good as my peers in mathematics.	Female	11	1	7
	Male	3	2	2
15. My perception of my success in mathematics has changed for the better over the years	Female	9	5	6
	Male	5	1	1
16. I need to have a strong foundation in mathematics for my future career goals.	Female	14	3	2
	Male	6	1	0
17. I usually feel confident when trying to solve a math problem and know I will eventually get the correct answer.	Female	9	5	5
	Male	4	0	3
18. How I feel about my ability to do well in a mathematics course impacts my success in the course.	Female	13	6	0
	Male	6	1	0

**Table 4.2***Self-efficacy summary table (continued)*

<b>Question</b>	<b>Female / Male</b>	<b>Number that strongly agree/agree</b>	<b>Number that were neutral</b>	<b>Number that disagree/strongly disagree</b>
19. If I believe I will do well in a mathematics course, I tend to do well in the course.	Female	10	7	2
	Male	5	1	1

Here are some connections that can be seen in the table above:

- Two out of the eight students who were not confident in sharing their ideas with their class were the same two students who did not have an A or B in their math course.
- Three of the students who thought they were successful in math did not believe they were as good in math as their peers.
- One female student who did not believe she was successful in mathematics took BC Calculus and Differential equations and obtained either an A or B in both courses. A male student who did not believe he was successful in mathematics is taking Precalculus as a junior and has an A or B in the course.
- Even if a student believed they could get good grades in a math course did not mean they were confident in their mathematical abilities or that they believed they were successful in mathematics, and vice-versa.
- As the math courses became more challenging, the African-American students overall still had a positive view about their abilities and success in mathematics.
- Being successful in mathematics was linked to having a math related career (Noble, 2011), but the results showed that students felt they were successful in math even if their future career was not dependent on math.

- Three male students were not confident when trying to solve a math problem and know they will eventually get the correct answer even though research has shown that typically male students are overly confident in their ability to solve math problems (McClendon & Wigfield, 1998).

### Self-efficacy impacted by environmental factors

From the research, I posited that environmental factors have an impact on the self-efficacy of students. For this survey, the environmental factors that were taken into consideration were socio-economic status, parents/family, teachers, and peers.

**Table 4.3**

*Self-efficacy by environmental factors summary table*

Question	Female / Male	Number that strongly agree/agree	Number that are neutral	Number that disagree/strongly disagree
21. My interactions with my peers make me believe I am able to do well in mathematics.	Female	10	5	4
	Male	5	2	0
22. My interactions with a past math teacher helped me believe I am able to do well in a mathematics course.	Female	14	1	4
	Male	6	0	1
23. My interactions with my present math teacher helps me believe I am able to do well in a mathematics course.	Female	13	5	1
	Male	6	0	1
24. My parent(s) help(s) me believe I am able to do well in a mathematics course.	Female	11	6	2
	Male	6	1	0
25. My family helps me believe I am able to do well in a mathematics course.	Female	10	7	2
	Male	6	1	0

**Table 4.3***Self-efficacy by environmental factors summary table (continued)*

<b>Question</b>	<b>Female / Male</b>	<b>Number that strongly agree/agree</b>	<b>Number that are neutral</b>	<b>Number that disagree/strongly disagree</b>
26. My socio-economic status impacts how I feel about my ability to perform well in a mathematics course.	Female	4	5	10
	Male	2	1	4
27. My living environment impacts how I feel about my ability to perform well in a mathematics course.	Female	5	2	12
	Male	2	1	4
28. I believe my living environment has a positive impact on my success in mathematics	Female	9	6	4
	Male	5	1	1

Again, I highlight a few noticeable results in Table 4.3.

- The majority of participants felt their interactions with a past or present math teacher helped them believe they could do well in a math course.
- I hypothesize that the four students who disagreed that interactions with their peers made them believe they were able to do well in mathematics did not necessarily mean they had peers who did not support them or encourage their success, but the participants did not believe their interactions with their peers had much merit on how they felt about their ability to do well in a math course.
- Seventeen participants felt their parents help them believe they can do well in mathematics, with all but one male student strongly agreeing to the statement.

- Most of the students (14 out of 26) disagreed or strongly disagreed with the statement that their socio-economic status impacts how they feel about their ability to perform well in a math course. There was no obvious connection regarding if their parents owned a home or their highest education level obtained. A limitation of the survey is that it did not mention whether the impact was positive or negative. I hypothesize that these students believed being in a higher socio-economic status allowed them more opportunities to partake in math enrichment programs, which would make them feel better about their performance.
- Sixteen of the participants disagreed or strongly disagreed that their living environment impacted how they felt about their ability to perform well in a mathematics course. Upon analyzing where they lived, roughly half lived in a rural environment and the other half lived in a suburban environment.

### **Parental and Family Impact**

Surprisingly, all the participants, with the exception of one, came from a two-family household, whether they lived with their biological parents, or a step-parent. This contradicts the data collected from the 2016 Census that showed 66% of black children are from a single parent household (Data Center, 2020). The following table sheds light on how the participants felt about the impact their family members had on their success in mathematics and the support they received from their family.

**Table 4.4***Parental and family impact summary table*

<b>Question</b>	<b>Female / Male</b>	<b>Number that strongly agree/agree</b>	<b>Number that are neutral</b>	<b>Number that disagree/strongly disagree</b>
29. My parent(s) help me be successful in mathematics (helping with homework, giving encouragement, etc.).	Female	7	4	8
	Male	5	2	0
30. Other family member(s) help(s) me be successful in mathematics (helping with homework, giving encouragement, etc.).	Female	3	3	13
	Male	4	1	2
31. I believe my parents' education level impacts my success in mathematics.	Female	7	3	9
	Male	2	2	3
32. My success in mathematics is the result of my parents' relationship status.	Female	1	2	16
	Male	0	1	6
33. My parent(s) encourage me to do my best in mathematics courses.	Female	18	1	0
	Male	7	0	0
34. My family encourages me to do my best in mathematics courses.	Female	18	1	0
	Male	7	0	0
35. My parent(s) support(s) my goals in mathematics (to take higher level courses, to maintain good grades, etc.)	Female	18	1	0
	Male	7	0	0
37. My family supports my goals in mathematics (to take higher level courses, to maintain good grades, etc.)	Female	17	2	0
	Male	7	0	0

I highlight some of the most relevant or interesting numbers from Table 4.4.

- Only one participant disagreed that her parents positively impacted her success in math. This was also the only participant who did not live in a two-parent household, and the proxy indicated that she was in a lower socio-economic status.
- Most of the female participants disagreed or strongly disagreed that their parents helped them be successful in math by helping them with their homework or giving encouragement. There was no connection between the responses provided for this question and the education level of the parents.
- Most participants did not believe their parents' education impacted their success, but some believed strongly that it did.
- The relationship status of the parents had no bearing on the success of the participants
- All but one student agreed or strongly agreed that their parents encouraged them to do their best in a mathematics course.
- All but one student agreed or strongly agreed that their parents supported their goals in mathematics. The participant who was neutral on this question was the only participant where both parents only completed high school or earned a GED.

### **Teacher interactions**

The questionnaire examined the interactions students had with previous math instructors, and their current, or most recent, math instructor. In general, the responses were positive and indicated that the participants had, and still have, supportive teachers that help procure positive self-efficacy.

**Table 4.5***Teacher interaction summary table*

<b>Question</b>	<b>Female / Male</b>	<b>Number that strongly agree/agree</b>	<b>Number that are neutral</b>	<b>Number that disagree/strongly disagree</b>
38. A past instructor helped me be successful in mathematics.	Female	16	1	2
	Male	6	0	1
39. My present instructor helped me be successful in mathematics.	Female	15	3	1
	Male	6	0	1
40. A past math instructor helped me feel as though I could do well in math.	Female	14	4	1
	Male	6	0	1
41. My present math instructor helped me feel as though I could do well in math.	Female	14	4	1
	Male	6	0	1
42. A past math teacher encouraged me to take an advanced mathematics course.	Female	14	1	4
	Male	5	1	1
43. My present math teacher encouraged me to take an advanced mathematics course.	Female	5	9	5
	Male	4	2	1
44. My past math teacher motivated me to do well in a mathematics course.	Female	13	4	2
	Male	7	0	0
45. My present math teacher motivated me to do well in a mathematics course.	Female	15	3	1
	Male	6	0	1
46. I have felt as if a past math teacher did not believe I could do well in math because of my race.	Female	8	1	10
	Male	4	0	3

**Table 4.5***Teacher interaction summary table (continued)*

<b>Question</b>	<b>Female / Male</b>	<b>Number that strongly agree/agree</b>	<b>Number that are neutral</b>	<b>Number that disagree/strongly disagree</b>
47. I have felt as if my present math teacher did not believe I could do well in math because of my race.	Female	1	0	18
	Male	0	0	7

Things to point out:

- Past and present math teachers helped most participants be successful in mathematics and fostered positive self-efficacy.
- Most past math teachers encouraged participants to take advanced math courses.
- There were a few cases, twelve out of twenty-six where participants thought their teacher doubted their capabilities in math because of their race.
- All the male students agreed or strongly agreed that a past math teacher motivated them to do well in a math course.

### **Peer interactions**

Peers are considered to be all the students that the participants interact with during school, but with a focus on the students in the same classes. The questionnaire did not go into detail as to the demographics of the classes, but if the assumption is made that the classroom reflects the general demographics of the area, than the classes would be comprised of mostly Caucasian students with some African-American and Latinx students.

**Table 4.6***Peer interaction summary table*

<b>Question</b>	<b>Female / Male</b>	<b>Number that strongly agree/agree</b>	<b>Number that are neutral</b>	<b>Number that disagree/strongly disagree</b>
48. I have felt as if my peers did not believe I could do well in math because of my race.	Female	10	3	6
	Male	4	0	3
49. My peers applaud my success in mathematics.	Female	10	4	5
	Male	6	1	0
50. My peers encourage me to do well in mathematics.	Female	11	5	3
	Male	7	0	0

I highlight a few of the overall results from these questions:

- Generally speaking, the participants had peers that positively impacted their success in mathematics.
- More than half of the participants (14) believed their peers had at one point or another had a negative impact on their self-efficacy, and three were neutral. The response to this question was not specific to a geographic location or gender.
- All but one of the males agreed or strongly agreed that their peers applauded their success in mathematics, while only ten of the females agreed or strongly agreed with the statement. From the data, it would appear that the female participants did not feel as if their peers applauded their success as much as the male participants. What participants would consider as applauding their success was not specified in the survey.
- All male participants agreed or strongly agreed that their peers encouraged them to do well in mathematics.

## Other Opinions and Views

The final questions of the questionnaire asked examined how the participants viewed the abilities of female students in mathematics and African-American students overall. Keeping in mind the observations of the Critical Race Theory, the last question asked if the participants believed African-American student had the same opportunities presented to them as other races.

**Table 4.7**

*Other summary table*

Question	Female / Male	Number that strongly agree/agree	Number that are neutral	Number that disagree/strongly disagree
51. Females are just as good in mathematics as males.	Female	18	0	1
	Male	7	0	0
52. I believe African-American students can do well in a mathematics class.	Female	19	0	0
	Male	7	0	0
53. African-American students are given as many opportunities to be successful in mathematics as people of other races.	Female	3	2	14
	Male	1	0	6

I note the following observations that can be seen in Table 4.7.

- All but one student strongly agreed that females were just as good in mathematics as males. The student who disagreed was the same female who indicated throughout the survey that they had little confidence in their ability to do well or succeed in mathematics.
- Every participant strongly agreed that African-American students were capable of doing well in a mathematics class. This means that regardless of race, socio-economic status, or

environment, African-American students believe their race was not a hindrance to them doing well in mathematics.

- More than half of the participants did not feel as if African-American students were given as many opportunities to be successful in mathematics as people of other races. This coincides with the idea from Critical Race Theory that African-American students are not given the same opportunities as Caucasian students (Chang, 2013).
- It was clear that as a whole, most African-American students see a discrepancy between opportunities they were presented with and those of their peers.

### **Students' Beliefs About Their Self-Efficacy and the Connections They Perceive Between Their Self-Efficacy and Environmental Factors**

As mentioned in Chapter 3, a number was given to each response of the questionnaire and an average value was calculated per student for each factor mentioned above (Punch, 2007). Recall, an average value greater than or equal to 3.5 indicates that that individual felt that the factor had an impact on her/his self-efficacy or success. An average value less than 3.5 and greater than 2.5 means the factor has a neutral impact. Lastly, an average value less than or equal to 2.5 suggests the environmental factor had no impact, or a negative impact on the student, depending on the question.

### **Overall Perceived Student Self-Efficacy**

Questions 10 through 19 asked questions that related to self-efficacy in mathematics, so the responses to these questions were used to determine how the students rated their overall self-efficacy in mathematics.

**Table 4.8**

*Student perceived self-efficacy*

<b>Student Perceived Self-efficacy</b>	<b>Female / Male</b>	<b>Number of Students</b>
Positive perceived self-efficacy	Female	12
	Male	5
Neutral perceived self-efficacy	Female	6
	Male	1
Negative perceived self-efficacy	Female	2
	Male	0

Noteworthy findings to point out:

- One of the female students who had perceived negative self-efficacy in mathematics also did not have an A or B in her mathematics course and marked on the questionnaire that she did not believe she was successful in mathematics.
- The other female student who had perceived negative self-efficacy indicated on the questionnaire that she was not confident she could learn math or do well in a math course. However, she did have an A or B in her current math class.
- No male students had negative self-efficacy, even the male student who did not have an A or B in his current math course.

### **Perceived Self-Efficacy Impacted by Environmental Factors**

Next, how self-efficacy was potentially impacted by environmental factors was examined. These environmental factors included parents, teachers, and peers, but also socio-economic status, living environment, and highest education level obtained by the parents.

Questions 21 through 28 asked the participants how they felt about the influence environmental factors had on their self-efficacy.

**Table 4.9***Student perceived self-efficacy influenced by environmental factors*

<b>Environmental Factor</b>	<b>Female / Male</b>	<b>Positive influence</b>	<b>Neutral Influence</b>	<b>Negative Influence</b>
Peers	Female	10	5	4
	Male	5	2	0
Teachers	Female	15	3	1
	Male	6	0	1
Parents / Family	Female	13	4	2
	Male	6	1	0

Some comments about interesting highlights of Table 4.9 follow:

- More students thought peers had a negative impact on their self-efficacy more than any of the other environmental factors. The students with the perception of negative peer impact were from various areas of the southeastern United States with no indication of a connection between where they lived and the negative impact.
- One female student indicated that none of the environmental factors had an impact on her self-efficacy. This student had a perceived negative self-efficacy overall.
- The male student who indicated teachers had a negative impact on his self-efficacy responded that his parents/family had a positive impact on his self-efficacy. The values were extreme opposites.

**Table 4.10**

*Student perceived impact of environmental factors on self-efficacy*

<b>Environmental Factor</b>	<b>Female / Male</b>	<b>Impact</b>	<b>Neutral</b>	<b>No Impact</b>
Socio-economic status	Female	4	5	10
	Male	2	1	4
Living environment	Female	6	5	8
	Male	3	3	1

Some implications from Table 4.10 are:

- Most student believed their socio-economic status did not have an impact on their self-efficacy. The questionnaire does not provide more details as to why the students who did possibly believe their socio-economic status had an impact felt the way they did.
- The student that the proxy indicated did not come from a middle-class family marked that her socio-economic status and living environment did not have an impact on her self-efficacy.

### **How Students Thought About the Connections Between Success and Environmental Factors**

The remaining questions reported in this section pertained to the environmental factors and how they could potentially impact the participants' success. Questions 29 through 37 looked at the interactions between the participants and their parents and other family members. Because of personal experience and previous research, some of the questions pertaining to teachers and peers were modified to explicitly ask if the students had negative interactions with the two. As a reminder, to accommodate for the negative impact, reverse numbering was used on the questions

that were worded in a negative manner. Questions 38 through 47 asked about the students’ interactions with their teachers. Finally, Questions 48 through 50 asked the participants about their interactions with their peers. The table below shows a summary of all the students’ perceived views of the influence of environmental factors on their success in mathematics.

**Table 4.11**

*Student perceived influence of environmental factors on success*

<b>Environmental Factor</b>	<b>Female / Male</b>	<b>Positive Influence</b>	<b>Neutral</b>	<b>Negative Influence</b>
Parents / Family	Female	9	9	1
	Male	7	0	0
Teachers	Female	14	5	0
	Male	6	0	1
Peers	Female	7	9	3
	Male	5	2	0

Below are a few notable results from Table 4.11:

- The one student who did not believe their parents positively impacted her success was the only student who was not classified a middle class and both of her parents obtained their high school diploma or GED.
- The one student who indicated teachers did not have a positive impact on his success was the male student who did not have an A or B in his math course and indicated he had negative experiences with his present math teacher. He selected that he felt as if a past math teacher did not believe he could do well in math because of his race.
- The three female students who perceived that their peers negatively impacted their success in mathematics were from the same geographical area, all three living within

an hour of each other. However, there were three other female students who live in the same area that did not share their perspective.

In summary, I note that the majority of the participants felt environmental factors had some impact on their self-efficacy in math. Most participants pointed out that they believed their parents, teachers, and peers had a positive impact on their self-efficacy and success in mathematics. Peers were more likely to negatively view the abilities of the participants in math because of their race. Overall, the African-American high school students had positive self-efficacy in mathematics, for both male and female participants with no indication that socio-economic status, living environment or education level of their parents had an impact on their self-efficacy. In the next chapter, we take a closer look at the individual student narratives.

## Chapter 5: Individual Student Narratives

Chapter 5 takes a deeper look into the lives of five of the nine participants that were interviewed. These five students were selected because they provided a unique perspective when it came to either their family interactions or experiences they had with their teachers or peers. For each student represented in this chapter, more details are provided about their background and what type of environment they live in. Also, their interactions and relationship with their parents, siblings, if applicable, and other family members are examined. Teacher and peer interactions were two factors that was found to be of importance according to previous research so a section each is dedicated to the participants' interactions with their teachers and peers. Finally, the factor of self-efficacy and how that impacted each student and their success in mathematics is looked at closely. These five student narratives demonstrate counter-storytelling as described by Critical Race Theory. The narratives presented were member checked to ensure that the views of the participants were accurately depicted. I emailed each of them a copy of their narrative and instructed them to let me know if anything was presented inaccurately or if I needed to change the wording. All five of the students indicated by email that they agreed to what was written and it represented their experiences.

### **Trey**

#### *Trey's background*

The first words that come to mind to describe Trey are vivacious and optimistic. Whenever you see him, he is always smiling and giving words of encouragement to his peers. He is very friendly and a clear extrovert who does not mind being his true self regardless of where he is. Trey comes from a two-parent household in the south-eastern part of the United States, where he lives with his mom, dad, and older sister. His parents own their own home

located in a rural community. He describes where he lives as a small town “that is not really well funded for education”. When Trey is not completing homework assignments or studying for exams, he runs track for his school’s track team, and plays soccer. He is a music enthusiast who also sings tenor in a spiritual based choir.

When asked about his experience in mathematics during his academic career, Trey mentions that he has known the importance of education and has strived to be successful in mathematics since he was young. Growing up, his parents impressed upon him the importance of trying his best and making the most of his education. He said his parents were “always there” for him and supported whatever he has tried to accomplish. He is always trying to complete extra work in his math courses in order to help him reach his goals. Trey strives to take higher level mathematics courses as he understands that his future goals require him to take such courses and he needs as much exposure as possible to what he will face in college and eventually the workforce. At the time of the interview, the highest mathematics course Trey had taken was AP Calculus BC. Even though Trey comes from a small town, various outside forces “have a big impact” on his self-efficacy and he believes that he receives the support of the whole community.

#### *Parents and family members*

Early in the interview, it was evident that Trey has a very close relationship with his parents, sister, and other family members. He also emphasized how important education is within his immediate family. His mom earned a 2-year degree from a local university, whereas his dad completed high school but did not continue his academic pursuits. When speaking of his dad, Trey exudes respect and pride that even though his dad did not go to college, he still taught Trey the importance of receiving an education and doing his absolute best. The educational

experiences of Trey's dad were an inspiration to him, and Trey used those experiences to help guide him and motivate him to strive for excellence and put "110%" in everything he did. Since his mother is a Pre-K teacher, Trey mentioned that his mom takes education very seriously.

During the summertime when other children would spend time playing video games or hanging out with friends, Trey would also partake in some form of education enrichment activity in order to continue to strengthen his brain. He did not mind these summer activities because he felt that it helped to prepare him for the upcoming school year and ensure that he was able to continue to perform well in mathematics, and other courses.

Being that Trey's family holds education in such high esteem, it came to no surprise that they provided positive verbal encouragement for him to continue to work hard and achieve in mathematics. They would say "you can do this" in order to try to boost his confidence whenever he faced a challenging concept that he could not grasp right away. Trey's parents have always been supportive of his academic pursuits, but after he reached Math I, they were no longer able to help him with his math homework. However, they did not let that stop them from providing support the best way they could. They would stay up late with Trey when he was trying to solve a complex problem and even try to help him look up possible approaches to solving the problem on the internet. Their lack of understanding of the concepts did not dampen their desire to assist him. Not only did Trey's parents provide verbal support, but they also provided emotional support. Trey mentioned that one time after he received a failing grade on a math quiz, he called his mom in tears and she reassured him that he was more than capable and even though he faced a small setback, he would do better the next time. From a young age Trey and his sister were told to believe in themselves and his parents laid a strong foundation for their academic success. His parents push Trey to do his best in every mathematics course he takes and to continue to

push forward regardless of the stumbling blocks he may face. Trey said he can always count on his parents to be there for him and to talk to when he is feeling down. They are constantly cheering him on and trying to boost his ego with their verbal encouragement. His mom even said, “Just because something is hard doesn't mean you're not capable of doing it”.

Trey not only spoke of his interactions with his parents, but also how his older sister has helped him navigate the often murky waters of education for a young African-American student. Trey's sister is only two years older than he is, but they have always been very “tight” and supportive of each other. The small difference in their age allowed them to develop a friendly competition to see who would earn the highest grades. He is very proud that throughout her academic career, his sister has received top scores in her mathematics courses and plans to become an elementary school teacher in the future. Being that they are so close in age, Trey and his sister often studied together while they were growing up. They worked on flashcards together and oftentimes his sister would teach him concepts she was covering in class to help prepare him for when he would take the same course. One of the most important lessons Trey learned from his sister was how to navigate math and school in general. Many of Trey's teachers had previously taught his sister, so she could give him pointers on how to interact with them and their teaching style. Throughout the interview, Trey constantly mentioned how “super supportive” his sister is and how much he appreciates working together and the help she has provided him with his homework. Trey's sister takes the time to help him understand difficult concepts, listens to his goals and aspirations in mathematics, and simply guides him to make sure he stays on the right track.

During the interview, Trey mentioned how thankful he was to have the support of his entire extended family. One aunt has been instrumental in making sure that Trey is on the right

track when it comes to the mathematics courses he enrolls in and being able to advocate for his academic needs. She is his “super encouraging aunt” who has always been there to support him. She is persistent in making sure things were the way they should be in school and provides guidelines for Trey and his sister to follow. She also took Trey to educational activities in the summer to make sure he retained everything he learned the previous school year. His extended family, who he described as “big and loud” all push him and check in with him to make sure he is doing well in mathematics, and all his other courses. Trey’s moral standards and the young man he has been molded into are heavily influenced by his immediate family and extended family.

### *Teachers*

As mentioned before, Trey grew up in a small town that did not receive a lot of funding for education. He said “I’ve definitely had my share of bad teachers and all it really takes to be a good teacher is for you to just extend a little extra effort to, like, get to know that student and make sure that they’re okay not only with the material in the class, but just, like, in life in general”. Essentially, according to Trey, the difference between a good teacher and a bad teacher is whether or not the teacher cares about the student as a whole, or just what score they will make on a state-given assessment. Trey mentioned that he cared more about the opinion of his teachers than his peers, so when he was “made to feel like not a bad student”, it impacted his views of his abilities in mathematics and whether or not he could be successful in a mathematics course.

To support their students, Trey suggested teachers should put in a little extra time and effort, whether that means helping the student outside of class or providing extra review materials. Teachers should make a point to try to talk to students outside of class to let them

know that they care about them and the relationship they have. A quick check in at the start of class goes a long way in letting students know that their teacher cares about how their life is going overall. A friendly learning environment and positive atmosphere are also of the utmost importance. These qualities help ensure that all students feel supported and valued, hence more likely to participate in class and retain more information. A good teacher would “never let students self-deprecate”, meaning that when a teacher hears a student speaking negatively about their abilities in math, the teacher should reassure them that regardless of grades or other situations, they are capable of being successful in mathematics. Another time Trey felt supported and encouraged by his math teacher was when he received a failing grade on a Precalculus assessment and began crying in the middle of class. Instead of ignoring him, his teacher quietly took him to her office and sat down with him to talk about what was going wrong and how he could do better. Allowing that moment of vulnerability and reflection meant a lot to Trey and let him know that he was more than a number to his teacher.

Coming from a small town, Trey also experienced the negative impact of having teachers that were not as supportive of him. Trey felt his Math 3 teacher targeted the black students in his class. He would only ask them if they understood the math homework, but for all the other students, he would imply that they did not need additional help. It hurt Trey to think that his teacher would doubt his capabilities in math simply because of his race. He was the first math teacher Trey encountered that made him feel as if he did not belong in an advanced math class because he was black.

### *Peers*

Throughout the time Trey has been in school, he has only had peers that were positive and supportive of his efforts. This is mainly because he does not “associate with negative peers”

and once he realizes a peer talks down to others or makes them feel inferior, he will no longer fraternize with them. As seen with his parents and teachers, Trey receives verbal encouragement from his peers. They often encourage him to participate in class discussions by putting his answers up on the board, but they also have friendly competitions. Trey's peers believe in his abilities and they push each other to do better. His peers work with each other to understand concepts and study together for assessments. They want to see each other achieve and succeed in mathematics, so they stick together and even struggle together to keep moving forward. Trey spoke on the importance of having a support system and having peers who understand what he is going through as an African-American student taking advanced mathematics courses.

### *Self-factors*

Trey had support and encouragement from family members and people within the community, but he also found encouragement and support within himself. Whenever he scored well on an assessment, it boosted his confidence and made him say "I can do it". He strongly believes he can handle any high-level mathematics course, even if he has to "struggle". He has always seen himself as being "kinda gifted" in mathematics and takes offence if someone doubts his abilities. Even with his high confidence, Trey does still have moments of doubt. Many times, those moments of doubt are fueled from a low score on an assessment or when his teacher or peers try to doubt his abilities. Trey also encourages himself by having self-pep-talks and pushing himself to try harder and put in hard work by studying. He is naturally a driven and self-motivated individual, so applying himself in mathematics comes second nature. Trey said, "if you want it bad enough, you'll get it", which is a testament to his perseverance.

## *Summary*

Trey is fortunate to have support and encouragement in mathematics from various sources. Overall, his teachers have encouraged him to do his best and reinforced that he is more than capable of doing well in any mathematics course he takes. With the exception of one instructor, his other teachers cared about him as a person and did not let his race cause them to doubt his abilities. In addition to having teachers to support him, he also surrounds himself with uplifting and supportive peers. They try to build each other up when they feel defeated from tackling difficult concepts and also applaud one another's achievements. Trey's sister, aunt, and other extended family members also influence Trey's self-efficacy and the success that he has achieved in mathematics. Their encouraging words and guidance have helped Trey develop a sense of achievement and self-efficacy in mathematics.

Of the many positive influences Trey has in his life, he said that he believes his parents have had the most impact on his self-efficacy and success in mathematics. His parents helped build his self-esteem from an early age, and even though his positive attitude towards his abilities in mathematics wavered at times, the support of his parents caused him to keep "pushing forward". Trey said that his parents wanted to see him succeed so he in turn wanted to succeed in order to make them proud. Their desire to see Trey succeed in his mathematics courses caused him to try his hardest and never give up regardless of the obstacles he faced. Even though his parents were not always able to help him with his homework, their verbal support and encouragement were enough to keep Trey motivated and determined to do well in mathematics. Trey summarized his experience in mathematics with influence from his parents the following quote: "I think the ultimate thing that they can really do is support you... I think for sure that if

every parent, like, gave their kids just a little minimum of support... just a little push in the direction of being greater than they think they are, then they would”.

## **Star**

### *Star's background*

Upon meeting Star, she appears to be a young lady of few words, but once she gets to know someone, she begins to open up and does not mind sharing her views of the world and how she fits in it. Star is the older of two children, and lives in a rural community in the southeastern part of the United States. Her parents own the home she lives in with her mom, dad, and younger brother. Both of her parents earned a 4-year degree, which Star believes has a positive impact on her success in mathematics. Star would like to eventually become a pediatric neurologist, and even though math is important, she will only need a basic understanding of mathematics to achieve her career goals. During her free time, Star supports her 12-year-old brother as he travels across the area competing in junior level car races. Prior to the interview, the highest level of mathematics Star took was Precalculus.

### *Parents and family members*

Star mentioned that her parents did usually support her by providing verbal encouragement, but at the same time, some of their “verbal encouragement” doubled as destructive criticism. When Star received a low grade on her math test and called her parents in hopes of receiving validation and reassurance, Star’s parents said she was overly dramatic. Her mom told her that tears were a sign of “being small” and therefore she should not cry over not doing well in her math class. Star seems to have a slightly strained relationship with her parents when it comes to her academics. Except for an occasional “You got this”, they always provide minimal verbal support and expect her to obtain A’s and B’s, regardless of the difficulty of her

classes. Their verbal encouragement seems to be a coping mechanism to get Star to stop whining or complaining than to provide the comfort she is seeking. Even after transitioning to a more advanced school, her parents still expected Star to receive A's and B's with no exceptions. Star stated that she does not receive help from her parents, outside of verbal support, and does not expect to. Essentially Star's parents believe she "should be doing well" and will not accept any excuses for her not having "high grades". According to the survey, Star strongly disagreed with the statement that her parents helped her be successful in mathematics or that the level of education they reached impacts her success in mathematics.

As mentioned previously, Star has a younger brother who drives in junior league race car competitions. When asked about how she viewed her brother's accomplishments in mathematics, she said that he receives good grades and does "pretty good" in his mathematics courses. She liked the fact that he will ask for help when needed instead of struggling to understand challenging concepts. With having a younger brother, Star knows that she must do her best in mathematics as he looks up to her for inspiration and she must set a good example.

Star's extended family celebrates her achievements and let her know that they are proud of all that she has accomplished. Star's extended family include members of her community that have no blood relation to her but have seen her grow up through the years and let her know they are happy for her. Just like her parents, her actual extended family expects her to get good grades. However, it is nice to receive the occasional "I'm proud of you" that comes with achieving good grades.

### *Teachers*

According to Star, it is not helpful when teachers work through practice problems over and over on the board but provide little to no notes for the students to write down. This form of

teaching causes the majority of the class to be confused and not recognize the connection between the concepts they are learning. Teachers should also not assume that students remember concepts from previous courses, but they should review them in order to help students understand how older material is still relevant to current concepts. To Star, it was very important how she was taught by her instructors as a negative experience in a course can make Star have a negative view of mathematics. The negative views of mathematics could possibly change in the future if a positive event occurs, but it is a challenge to overcome the initial perception.

Star had an older white female teacher who was rude to her for no apparent reason and another teacher who would never allow her to ask questions in class, which caused Star to be afraid to ask for help in most of her classes. There was also a time where she felt that her teacher did not like her for some unknown reason, which made Star apprehensive about participating in class at all. Yet, another teacher refused to answer Star's questions, so Star took it upon herself to go to the board to write her question down for all to see. Granted, this behavior was outside of the norm for Star, but she did not understand why her teacher would not call on her as she raised her hand to ask a question. It would have been different if Star interrupted the teacher while she was speaking, but the teacher was at a point that felt like a natural pause in the lecture.

Star believes it is important to have a teacher that will help build the confidence of the student instead of making them feel inadequate or unable to ask for help when they need it. It is important that students are allowed to ask questions, or they will not be able to close the gaps in their understanding. A teacher should encourage students by pushing them to do the best they can in mathematics and allow them to ask questions when needed. Verbal encouragement is also very important, and it goes a long way if teachers are simply nice to students and try to offer their help and support. A negative attitude about teaching is obvious to students and can cause a

student to not want to become invested in the course. It is also important that the teacher cares about the students and the relationships they have, versus how well the students do on standardized tests.

Other ways that students can achieve success in mathematics from the support of their teacher are if the teacher provides notes for the students or records the lectures given in class. The class should also be well structured to ensure that students are able to follow along with the lecture and ask questions as needed. Organization goes a long way in helping to make sure students do not become confused and are able to see the connection between, and to, other concepts. Having a teacher that she can relate to is also important to Star, but not necessary for her to be successful in a mathematics class.

### *Peers*

Even without meaning to, Star finds herself comparing herself to her peers, but she does not necessarily focus on their grades or their success in the class, even though those topics do come up. Being a very competitive person, Star has friendly competitions with her peers to see who is able to earn the highest grades. Star benefits considerably from working with her peers as they are able to learn from each other, even if they must struggle together.

Star said that it is also important for peers to stick together and look out for each other. It is great when peers are willing to help each other and even provide tutoring when needed. However, at her previous high school, Star experienced a few situations that made her weary of who she worked with in class. She stated that she did not want to work with certain people from the belief they would just use her to obtain the answers to the problems.

### *Self-factors*

Star felt the best about her ability to be successful in mathematics when she received high scores on her assessments. They gave her the confidence she needed and the ability to say, “I know it” or “I can do this”. Though Star has positive self-efficacy and the support of those around her, she still experiences moments of confusion and lack of confidence. Much of her negative self-efficacy comes from not understanding the material or believing that the class is too difficult. Star stated that her confidence was not where it should be and mathematics did not come easy for her, rather she had to work very hard to achieve the success she had. Surprisingly, Star believed that males are smarter than females in mathematics because they can see the “big picture” and do not get caught up in minor distractions. Star encourages herself to do well by saying that she is “doing her best” and that she has to work hard at it. Again, Star has a natural competitive nature, so if she sees a classmate doing better on assessments or their understanding, she will take it upon herself to try even harder to become better than the person she is competing against.

### *Summary*

Star receives verbal support and encouragement from her extended family and peers, but not as much as she would like from her parents. Her strained relationship with her parents is evident when she speaks of the pressure they place on her to excel academically, while at the same time, they do not provide the type of support she truly desires. It is great that her parents care on some level about her doing well in mathematics, but it would be more beneficial to Star if they provided attention and support in a more positive form. Her extended family is more likely to say they are proud of her than her parents, which makes Star feel as if she cannot go to them when she needs moments of reassurance, hence she clings to the encouragement provided

by her teachers. In her relationship with her peers, Star is selective of who she interacts with in order to not be taken advantage of. Her distrust for why others want to work with her leads to her not associating with peers who could potentially support her academic goals.

Teachers had the most impact on the success in mathematics and the self-efficacy of Star as it relates to mathematics. Regardless if the teachers were at her previous high school or her new high school, Star felt as if her teachers hold the key to her doing well in mathematics and believing in her abilities. Star believes that her teachers had the most impact on her success because they “control everything” meaning, they control her assessments, her grades, what material is covered, and how the concepts are presented. If a teacher has verified that what Star turned in was of great quality, then she will consider what she has accomplished a success. In a similar fashion, teachers also have the most impact on Star’s self-efficacy because, again, they “control everything”. They are able to provide the resources and help that Star needs to do well in a course, which then impacts her self-efficacy. How teachers teach “determines how I feel about the subject and” my “willingness to work”. If a teacher does not buy into the importance of a topic, it is more than likely that neither will Star.

## **Randy**

### *Randy’s background*

Randy is a quiet young man who enjoys spending time with his friends and singing for the school’s choir during his free time. He stays in a house that his parents own in a suburban neighborhood located in the southeastern part of the United States with his mom, dad, younger sister and younger brother. He also has two older sisters, but they are in college and have moved out on their own. Both his parents obtained their master’s degree, but they do not demand that Randy must also earn a master’s degree, or higher.

Randy's desire to be successful in mathematics began at an early age, and his parents have always encouraged him to try his best regardless of the obstacles he faced. To become proficient in accordance with his perspective, Randy completed extra math worksheets outside of class during his early school days and was determined to always take the most advanced mathematics course available to him. He desires to major in mechanical engineering, or industrial design, and understands that having mastery of high-level mathematics is important.

#### *Parents and family members*

It is important to Randy that his parents understand that he can succeed in mathematics. To him, this means that even if Randy is having difficulty in a course, knowing that his parents understand he is still capable to do well in the course means a lot to him. Randy's parents helped him build self-efficacy in mathematics because they would tell him that he could succeed in a math class. They provide moral and verbal encouragement to help him believe he is able to do well in any mathematics course he takes. His parents do not help him with his math work, but they would provide a tutor if one is needed. Randy appreciates the fact that his parents check up on him in his math courses by making sure he stays on top of his homework and asking how he feels about how he is doing in the course.

When asked about his views on how his sibling performed in mathematics, Randy's answers covered a wide range. He said overall that his siblings performed well in mathematics by achieving good grades, and that was mainly the result of their parents' support and encouragement. His oldest sister did "pretty good" in mathematics but was lacking in her work ethic. This means that even though she achieved decent grades, she did not apply herself as much as Randy thought she should, and therefore he did not believe she reached her full potential. In a way this made Randy proud that she did well in math without putting in much

effort, but at the same time, he felt that if she did try harder, she would perform even better.

Randy's second oldest sister is not as "naturally gifted" in mathematics and has to work harder to achieve good grades. He believes she will be more successful in mathematics in the long run because she tries to actually understand the concepts, rather than just learn enough to get by.

Randy's younger sister and brother appear to have a strong foundation in mathematics. Before Covid-19, they both attended Kumon once a week to develop their mathematical knowledge and work on additional worksheets outside of class. Being able to help his older siblings with their math homework helps to boost Randy's confidence. His siblings also provide him verbal encouragement and he considers them to be his "cheerleaders".

Randy is not very close to his extended family, but said they also try to provide verbal encouragement. As with his siblings, Randy called his extended family his "cheerleader" as they are always willing to provide words of encouragement when needed.

### *Teachers*

It is not anything new to know that non-black students are treated differently than the black students in many situations (personal experience). Randy spoke of a few instances where he felt as if his teacher made him feel down about his ability to do well in math. It did not help that he felt he was not understood by the teacher and his teacher did not try to accommodate the learning style of the majority of the students, who happened to be African-American. This caused Randy to be bored in class and disinterested.

His Math 3 teacher did not make Randy feel as if he cared how Randy, or his peers, did in the class. There were times Randy would attempt to participate in the class discussion by volunteering to answer the question, and his teacher would simply overlook him. He was never called on to answer questions, and the teacher would go as far as not to answer the questions

Randy asked. Randy did not believe the teacher was an outright racist individual, but his actions had racist undertones. In a few courses, Randy felt as if the instructor did not understand him as a person which led to him not feeling supported in the class.

Thankfully, not all of Randy's interactions with his teachers were negative. Many of his teachers provided verbal encouragement by simply saying "you can do this". One significant way the teachers could support students is by offering to help them and providing more than one way to "do the math". Obviously, not every student will approach a problem the same way, so having multiple avenues to maneuver is reassuring and impactful for students who may want to take a different approach. According to Randy, it is also important for teachers to care about students and not just test scores. Providing a positive atmosphere in the classroom to help students feel comfortable is also essential. Though not always possible, if a teacher can present math in "an exciting way", that helps students become more engaged and invested in the course. Allowing students to ask questions and providing extra resources are other ways teachers can support their students in mathematics. Simply "being there" for the student can go a long way. Randy mentioned that representation and having a teacher he can relate to is very important to him.

### *Peers*

Randy has experienced negative comments from his peers regarding his abilities to do well in mathematics. If he answers a question incorrectly in class, he has witnessed his peers laughing at his mistakes and making snide comments. His peers assume they will not benefit from listening to his ideas, even though he typically has a valid approach and is correct in his thought process. This has caused Randy to be afraid of what his peers may think and therefore he is not as likely to want to participate in a class discussion. All of these negative experiences

have caused Randy to feel excluded and not supported by his peers at times. There were times when he would ask for help and his group member would reluctantly help him, if they decided to help him at all. Being he did not have a lot of peers from the same background, he did not feel as if his other classmates wanted to be bothered with working or learning with him. There was one instance where his classmates did work with him, but it was a situation where the entire class gave up on trying to understand the concepts their instructor was explaining. There were also cases where non-friendly competition occurred, and his classmates tried to perform better on assessments to prove that he should not be in advanced mathematics courses.

Thankfully, Randy has experienced having supportive and encouraging peers. Typically, his peers provide verbal encouragement, such as saying “you’re smart” or they will applaud his unique approach to solving a problem. At his new high school, they work together, and everyone is willing to help Randy to make sure that he understands the more challenging concepts.

### *Self-factors*

During the interview, it appears that Randy has both positive and negative self-efficacy when it comes to his abilities and capabilities in mathematics. When he does not understand the concepts presented, it makes him doubt if he is able to perform well in the mathematics course. Also, if he receives a bad grade on an assessment he studied for, it causes him to believe that he is not where he should be and maybe he is not truly successful in advanced mathematics courses. When teachers move too fast in a course, it causes Randy to not understand what is going on, which causes his confidence in his abilities to decrease.

In conjunction with moments of doubt, Randy also has positive views of his abilities in mathematics. When he performs well on an assessment, he has a boost of confidence and the

notion that he is indeed capable of succeeding in mathematics. It is also great when he is able to grasp concepts and explain what he knows to his peers. When Randy has his moments of doubt and frustration, he pushes himself to try harder and to spend more time focusing on the topics that he is having difficulty with. When he begins to receive better grades, it also creates a boost to his confidence. His number one motivation is his career goals and making sure he reaches every milestone in between so that he is in the right position to eventually major in mechanical engineering or industrial design.

### *Summary*

There were many outside forces that impacted Randy's self-efficacy and success in mathematics. He said "It's hard to believe that you can succeed, if you don't see other people who have done it already who look like you succeeding" which reiterates his view that representation is important. Unfortunately, Randy did not see much representation within the classroom, but his parents introduced him to people in the community who were doing well. Having supportive parents and siblings there to encourage him helped Randy to believe that even when he felt confused or frustrated by what was happening in his math courses, he was still able to do well in them.

What has the most impact on Randy's self-efficacy and success in mathematics has not been constant through his academic career. Prior to attending his new high school, he believed his teachers had the most impact on his self-efficacy. Since the teacher controlled his grades and provided him feedback on how he was doing in the class, they had a direct link to how he felt about his abilities. Having such negative experiences with his previous teachers, it is understandable that there were times when Randy did not have positive views of his abilities in mathematics. After attending a new school where the structure of the classroom is more student

centered and group work is encouraged, Randy felt as if his peers had the most impact on his self-efficacy. As the result of having more collaborative work, Randy was around his peers the most and felt they had a better view of how he was able to do in a course than the teacher. In both situations, his teachers had the most impact on his success. He felt that he could go to his teacher for help, and their help would either lead to him understanding the concepts and doing well, or not understanding, and therefore not considered successful.

## **Tam**

### *Tam's background*

Tam brings a unique perspective compared to the other students interviewed as her parents came to the United States from West Africa a few years before she was born. She is still able to visit her family in Africa and even though she does not see them as often as she would like, the entire family has a close relationship. One thing people will notice about Tam is that it takes a long time for her to become comfortable with others and begin to open up to them. She says that she has to “watch and learn” before she is willing to get too close to people she just met, as the result of negative past experiences where she encountered individuals that just wanted to use her. She is very loyal to her friends, but it takes her a while to trust new friends initially because she must figure out if there is an “ulterior motive”.

Coming from a rural area located in the southeastern part of the United States, Tam lives in a house owned by her parents with her mom, dad, and younger sister. Her mom is currently working on obtaining her GED, and her dad earned his master's degree in engineering at a university in western Africa.

Tam's motivation to do well in mathematics, and all her courses in general, began at an early age. “Early on” her parents pressed upon her the importance of education and trying her

best to succeed in all areas. Tam takes advanced courses in mathematics as she describes math as her “jam”, meaning, it is a subject she thoroughly enjoys. Even though she is a math enthusiast, she will only need basic math for her future goal of majoring in biochemistry and obtaining a minor in biomedical engineering. At the time of this interview, the highest math class Tam took was Precalculus, which was an accomplishment since she was not allowed to take Math I until she was in high school. Tam did not elaborate on why she was unable to take Math I earlier since she had always performed well in mathematics, but she took advantage of being able to enroll in more than one math course during the academic year while in high school.

#### *Parents and family members*

As mentioned previously, Tam’s dad obtained his master’s degree in engineering. Having taken so many math courses, he is able to help her with her math assignments and help her study for tests. Tam also believes that her parents provided a strong foundation for her to be successful in mathematics. She enjoys that fact that her parents are so supportive, and she can call her dad at any time to get additional assistance with a concept she does not understand. Though Tam’s parents provide an abundance of positive verbal encouragement, it is still expected that she does well in her math courses. They have high expectations of her, but also provide her with the support she needs to reach their expectations.

Education is very important to Tam’s entire family, especially her family members that still live in a small country located in western Africa. Her family members there must pay for school during their primary and secondary grades, but college is free. The idea behind this system is that if students make it to the college level, they are truly dedicated to their education and should no longer have to pay for it. Even with Tam’s family members not being in the area, they still celebrate her accomplishments. In her family, when you go out in public, you not only

represent yourself, but also your entire family. It is important for Tam to represent her family with pride and dignity, so she tries her best in all circumstances to reflect positively on them. Her extended family also provides her with verbal support and try to check in on how she is doing academically. Like with her parents, her extended family expects her to do well in mathematics, but they do congratulate her achievements and let her know they are proud of what she has accomplished.

Even though her sister is only in the fourth grade, Tam believes she is good in mathematics. She loves the fact that her little sister is ambitious and works hard to do well in school. Tam stated that her sister leans more towards the arts, but she still does well in her mathematics courses. Being older, Tam is able to help her sister with her math work, which helps build her sister's confidence in her ability to succeed in a mathematics course.

### *Teachers*

It is important that the teacher treats everyone the same, regardless of their race or gender, according to Tam. When teachers are insensitive to the needs of minority students, it Causes negative self-efficacy, in addition to when teachers doubt the mathematical ability of their minority students. Teachers should not come with the presumption that African-American students will not do well in a mathematics course. It is expected that teachers are not rude to students and do not speak to them in a condescending manner. Teachers should also be organized, and when they are not, it has a negative impact on self-efficacy. Having a teacher believe that she could do well in a mathematics class helped Tam have positive self-efficacy. Also, having a teacher that looked like her made it clear that someone of her race and gender could be successful in mathematics. Verbal encouragement and making Tam feel like she was "actually good" in mathematics was very important and had a positive impact on her self-

efficacy in math.

Having a “good” teacher according to Tam would be a teacher that has a methodical teaching approach and provided verbal encouragement. Simply telling a student “you can do this” goes a long way. Tam had an African-American female teacher who wrote personalized notes of affirmation to each of her students before they took the end of year state test. This simple act of kindness meant a lot to Tam and reassured her that she would do well on her test. Tam emphasized that she could relate to female teachers the most, especially female teachers of color, but having a teacher that offered support was critical. A nice teacher that cared about the students as people and not just test scores is a must and providing review material is a bonus. Once, Tam had a bad experience where the teacher did not teach the entire school year but preferred meaningless, non-math related conversations with the students every day. What Tam found to be most daunting about the situation was that her class was prominently African-American and this class was the foundation they needed to do well in succeeding math courses. With the many forms of discrimination that African-American students face, it is imperative that teacher help African-American students feel comfortable in the classroom, and if possible, make the students feel special by emphasizing they are capable of doing well.

### *Peers*

Tam mentioned the importance of having peers “like you”, even though they may be different personality-wise. The “like you” in Tam’s case means other African-American females. Having someone to confide in that understands the struggles she faces not only as an African-American, but as a female, is very important. Peers have often doubted her abilities, but she will turn their negative comments into a positive and still strive to achieve her goals. However, there have been times when Tam felt inferior because her peers rejected her answers.

She has experienced intimidation when going into a class with majority white students and no one who would be able to identify with the struggles she faces as being a minority by gender and race.

Even with so many negative experiences, Tam still has found peers that provide verbal encouragement when it is needed. They work with each other to understand concepts, and many of her peers are willing to tutor Tam when she is having difficulty understanding concepts. The peers that Tam currently interacts with the most support her and never make her feel inadequate.

### *Self-factors*

From an early age, Tam has demonstrated positive views regarding her abilities in mathematics. She said she “knew it” and was proud that she was able to score high on the end of grade tests and assessments. When she had a rather challenging Math I experience in which the teacher did not actually teach, she was still about to score a 4 on the end of grade course test, which was a pleasant surprise since she had to teach herself most of the concepts. Her confidence is evident in the following quote: “even though the year was not the best, it definitely was the best for math because I proved to myself, I could do anything... literally anything”. According to her, math just made sense and she has always been confident in her abilities in math. The only time Tam had a negative experience with mathematics was when she received a bad grade, but that did not occur very often.

Tam encouraged herself to do well in mathematics many times, especially when faced with an adverse learning situation or peers that were not supportive. She aimed to exceed the expectations of others and pushed herself to do her absolute best. When she had to teach herself and still managed to persevere, this was a major boost to her confidence. After realizing she must study mathematics or be at a disadvantage compared to her peers, Tam works hard to

understand challenging concepts and is constantly trying to go above and beyond to reach her next goal. She is very ambitious and does not mind doing whatever it takes to succeed.

### *Summary*

Tam recognizes that outside forces can have a positive or negative impact on an individual's self-efficacy in mathematics. Thankfully, Tam has never let the opinions of others impact her negatively. Her determination and dedication to fulfilling her goals help her overcome any negative experience she has. She appreciates the support she receives from her teachers, especially those who represent individuals like her, and the support from her peers. Most of their support comes in the form of verbal encouragement, but it goes a long way in reaffirming her beliefs.

Prior to her current high school, Tam believed her parents had the most impact on her self-efficacy in mathematics because her dad always helped her with her work and let her know she was able to do well. However, at her new high school, her teachers have the most impact on her self-efficacy. The reason for the change is that previously, her dad reiterated concepts that she learned in school and she did not only have help from her teacher. Now, Tam relies more on her teachers and their teaching methods. Her dad is still supportive and helps her when available, but the way her teachers teach directly correlates to how Tam feels about her ability to do well in the course.

Her parents also had the most impact on her success in mathematics at her old school because they laid the foundation for what she thought was important and where she put her effort. Her dad's help had a large impact on her ability to do well on tests, which led her to believe she could be successful in mathematics. As with her self-efficacy, she now believes her teachers have more impact on her success in mathematics. When doing work in the classroom,

Tam looks to her teachers to know if she is doing well on a concept, and hence, successful in the course.

## **Jackson**

### *Jackson's background*

Even though Jackson has consistently performed well in mathematics and other sciences throughout his academic career, he loves the performing arts. He is a member of two school choirs, a member of the creative writing club, and a member of the school's step team. In addition, he is a dancer in the school's dance troupe. Jackson proves that a person who has a passion for performing arts can still do well in the sciences.

Jackson lives in a small rural town with his mom, dad, and younger brother. Both his mom and dad earned a four-year degree from their local university. He stands out from the other students interviewed in that he has noticeably lower confidence in his mathematical abilities as the result of negative experiences. Jackson would like to go into the field of computer engineering, which would only require basic math, or computer science, which would require higher level mathematics. At the time of the interview, the highest level of mathematics Jackson had completed was Precalculus.

### *Parents and family members*

Jackson's parents provide verbal encouragement by advocating for him to keep pushing forward and to do the best he can in his math classes. The occasional "you got this" means a lot to Jackson. His parents do not help him with his assignments, but whenever they see that he is having difficulties with a concept, they let him know that they believe he is able to overcome any obstacle. They have always seen him do well, so they expect that regardless of what challenges he faces, he will continue to do well in mathematics. Jackson's parents check on how he is doing

in class and show concern for his progress. It is also expected from Jackson's extended family that he will do well in mathematics. As with his parents, they have known him to always do well, so they encourage him verbally and let him know that he has any difficult situation he faces under control. Since Jackson's brother is only five years old, he has not had a lot of experience with mathematics, but Jackson believes that his brother is off to a pretty good start. Currently, his younger brother is learning about the basics of fractions and appears to take a liking to mathematics already.

### *Teachers*

According to Jackson, teachers must be able to explain concepts well for them to have a positive impact on his self-efficacy. The teacher not knowing the material themselves can and will cause the student to doubt their own understanding. Teachers should also not assume students remember all the details from a previous mathematics course because more than likely, they do not. Jackson appreciates when a teacher reviews previous concepts before introducing new concepts. Having a teacher that is nice is also important to Jackson. Being nice means that the teacher provides verbal encouragement and corrects his answers in an enduring manner by not being condescending. Receiving an award to highlight his accomplishments, or simply receiving a compliment on his work, means a lot to Jackson. An occasional "good job" is also welcomed. One significant way a teacher supported Jackson was by encouraging him to pursue an advanced mathematics course. This act of support reiterated to Jackson that his teacher believed he could do well in an advanced mathematics course, and therefore he should have a positive outlook on his abilities in mathematics.

### *Peers*

Jackson's peers expect him to do well in mathematics because he has a reputation of

being “the smart kid”. The support he receives from his peers include them working together and studying together. They learn from each other and do not mind having to struggle together to understand concepts. When he is able to help his classmates remember concepts they have covered in class, it boosts his confidence and helps him believe he is able to understand and do well in mathematics. Jackson tends to compare his success and his grades to his peers. The comparison at times seems to be neutral overall, and he uses it as a way to gauge how he is doing in a class. When his peers give him compliments, Jackson feels better about how he is doing in mathematics, and when he realizes he has earned a higher grade on an assessment than his peers, his confidence increases. However, when there are times that his peers understand better than he does, he no longer feels as if he is able to do well in mathematics.

As with his parents and teachers, receiving compliments and verbal encouragement from his peers is essential. He has often heard “you’re smart” from his peers after he explains a concept to them or tries to help them with a problem. Jackson was very proud of a time in his Precalculus course when his peer acknowledged that Jackson had helped them remember an important concept. They shared what he taught them, and the teacher in turn shared with the entire class, validating Jackson’s idea.

Even with all of his positive experiences with his peers, there have been times where some of Jackson’s peers were not as supportive. Sometimes, his peers speak to him in a condescending tone if he does not understand a concept, or he can hear them whisper negative comments when he gets a question wrong. Seeing his peers do better than him on an assessment also causes Jackson to doubt his abilities in mathematics. Those negative experiences, though few and far between, still negatively impact Jackson’s self-efficacy as it relates to how well he believes he can do in a mathematics course.

### *Self-factors*

Jackson's confidence in his ability to do well in a mathematics course has declined as the courses became more challenging. He had positive self-efficacy in mathematics during his early academic career, but with more negative experiences, his confidence began to dissipate. A few things that cause Jackson to have low confidence is when he does not understand the material or when he is struggling with concepts. He would often find himself saying "why don't I get it yet" and looked down on himself when his peers understood material better than he did. Jackson recognizes that his confidence is not where it should be, but there have been numerous times when he "tried hard and still didn't get it". Another cause for concern is that Jackson believes he is missing something fundamentally, but not exactly sure what it is. Unfortunately, he often thinks that the other students are smarter than he is and he "feel(s) dumb". Being that Jackson performed so well early-on and is now facing more challenging courses, he compares his earlier success to where he is now and looks down on himself since he is not where he wants to be. Jackson said that he will try to take advanced math courses, but he will not take the hardest math classes available.

With so much self-doubt in his abilities in mathematics, Jackson does have moments of affirmation in his ability to be successful in a mathematics course. He identifies times when he knows and understands the concepts and he feel as if he is "mastering it". There were also several times when he performed well on assessments which made him feel better. Jackson has his largest confidence boost when he is able to explain concepts to others. To help himself overcome his negative self-efficacy, Jackson reassures himself that he is doing his best and he puts in as much effort as he can. He tries to learn the material, and if he comes up short, he tries even harder.

### *Summary*

Jackson's transformation from believing in himself in regard to mathematics has not gone in the direction that he would like. There are moments of reassurance, typically supported by his parents and peers, but they do not occur as often as his moments of doubt. Jackson does not know exactly when the moments of doubt began, but it appears to be linked to situations when those around him are catching on to concepts at a faster pace than he does, or after he receives a grade that he is not proud of. Through it all, he still has the support of his parents, family, teachers, and peers overall. They support him the most by providing him with encouraging words and being there when he is feeling down.

Not surprisingly, Jackson said his peers had the most impact on his self-efficacy in mathematics. They are constantly learning from each other and his interactions with them can either confirm or contradict that he has the capacity to do well. Having math courses that rely heavily on group work has increased the impact his peers have on his views. If he is consistently surrounded by those that provide positive feedback regarding his capabilities, he will more than likely believe what they are saying. Jackson contributes his success in mathematics to his teachers. In his eyes, they are preparing him for the future and to take higher-level math courses. If they do a great job of teaching, he believes he will understand better and obtain good grades, which he contributes as a sign of being successful in math.

## **Chapter 6: Results from the Interviews (All)**

In Chapter 6, all nine interviews are combined to discuss the factors that impact the success of African-American students as it relates to their parents, teachers, peers, and self-efficacy since these were the factors found to be of the utmost importance according to previous research. With each factor, the themes that emerged from the in-vivo coding are represented and explained in more detail.

### **Parent Factors**

Though siblings and other extended family members did have an impact on the individuals interviewed, parents overwhelmingly influenced the views and self-efficacy of the participants the most. All nine of the participants indicated that they believed their parents had a significant impact on their success in mathematics. The level of support their parents provided varied, but overall, they felt as if their parents were instrumental in their ability to do well in a mathematics course. In this section, I discuss themes that arose during the analysis of the interview data. The themes are:

- Parents that encourage
- Parents teaching the value of education
- Parents helping

#### *Parents that encourage*

The theme that came up the most as a factor that impacted all of the participants was having encouraging parents. Positive verbal encouragement was seen as the most common form of encouragement the parents could provide, as stated by Jackson, Trey, Sasha, Tam, Star, and Dee. Jackson's parents have always seen him do well in mathematics, so when he was having a difficult time, they provided verbal encouragement such as the following "... we've already seen

what you can do Jackson, so whatever this problem is, you got it. You have it under control. It might seem tough now, but we know that you can push through and excel... .” Randy and Dee felt their parents encouraged them by helping to build their self-efficacy through acknowledging their ability to do well in mathematics. Even though Tim did not directly state that his parents provided verbal encouragement, he did say that they pushed him to try his best in everything he does. This is evident when Tim said “I’d say people that push me to, like, try my best and do well even though I was already doing well, but, like, try and do as best as I can... definitely would be my parents... .” This sentiment of their parents pushing them to do their best was echoed by Trey and Dee. Regardless if the parents understood what the students were studying or not, they still provided verbal encouragement when needed. This is evident when Jackson said “... even if they don't really know what's going on in the math, they’re still like, you got it. We know you, you got it.” Tim also had a similar statement with:

I always felt, like, if I ever needed help they would be there... they'll be present and, like, at least try their best to help me even if they didn't know the material or they learned a different way back when they were in school.

Trey also spoke on how his parents provided verbal encouragement. In regards to his mom, he said “... she was always encouraging me that Trey you can do this or... Yeah always encouraging me to try my best and... she was kind of always there to push me forward and kind of boost my confidence and my skills.” Trey’s dad was not as verbal as his mom, but Trey still felt supported by him and encouraged, which is seen by the statement “... But as far as, like, encouraging me, he's (his dad) always been an incredible supporter.” Tam’s dad was also instrumental in providing verbal encouragement, pointed out in the following quote “... So definitely, he's always someone that really encourages me to do math. So, despite how hard it

would be... .' Even though the degree of verbal encouragement varied between the parents, it was a constant and influential factor for the participants.

### *Teaching the value of education*

A second theme I identified was parents teaching the value of education. Typically, the value of education was taught and reinforced at an early age. Four of the participants spoke on the importance of education their parents imparted to them while they were still young. Even with varying levels of education obtained by the parents, those who only graduated from high school and those who obtained a master's degree and beyond, they still valued education and wanted their child to have similar views. Tim's mom earned her master's degree while his dad earned a 4-year degree, but they both emphasized how important education is. Tim believed that his parents determined how much he valued education which is shown when he said:

... They get to you first. I guess it's a way to put (it), so they really determine, like, your values and how much you value education, to a great extent. So, like, if your parents didn't teach you to care, I guess you're probably not going to try or do well.

Tam also spoke of the foundation in education her parents, in particular her dad, created for her. "I would say, on my success (in math)... I'm going to say my dad this time because whenever I call him for help, he makes it... I think of the foundation that he has instilled in me." Trey also mentioned his strong foundation of his desire to do well in school that his parents conveyed to him, but his mom played the biggest role. Trey said:

I had such a strong foundation in my mom, she was kind of always there to push me forward and kind of boost my confidence and my skills. She's always preaching believing in yourself. That's something that she has taught me and my sister a lot about is knowing your own capabilities and that just because something is necessarily hard doesn't mean you're not capable of doing it.

Regardless of how Trey feels about his abilities in a course, his mom and dad both reiterate that education is important, and he should try his best to do well.

### *Parents helping*

Though not seen as often, parents helping their child with their math work was also discussed. Alex, Sasha, and Tam all said their parents helped them with their math homework. Many parents helped their child until they reached a certain level of mathematics. Dee said, “When I started high school, my parents were no longer able to help me with my math.” Trey also had a similar experience that he expressed by saying:

My parents couldn't always help me with the math I was doing, but, like, they wouldn't mind staying with me if I was struggling with a problem or something and they would help me look up things on the internet and, like, figure out how to... work through problems.

Tam's dad was the only parent who was able to help her with higher level mathematics courses as the result of having a degree in engineering. Tam's dad would even stop in the middle of what he was doing to help Tam, shown by the following quote “... he is definitely there for me to lean on. ... so many times, I'd call him... and he is there. He'll be at work (and) he'll take a 15-minute break to help... he will find a way to help me.” Even when the parents of Randy, Sasha, and Dee were not able to help them directly with their math work, they were still willing to hire a tutor as needed. Sasha appreciated the fact that her parents were able to afford a tutor for her and said “... junior year, my mom got me a tutor that was local that I worked with once a week because she wasn't able to help me and she wasn't physically with me, but she got me that tutor to help.”

### **Teacher Factors**

The participants in the interviews emphasized the major role the teachers played in their understanding of mathematics. It did not matter where the participants were located (although they were all in the same state), they all had similar experiences when it came to how their teachers helped them become successful in mathematics. There were some discrepancies

between the funding some schools received, evident in the type of courses students were allowed to take, but when provided with a teacher who genuinely cared about them, the students were still able to excel and reach their full potential.

### *Teachers that encourage*

Having an encouraging teacher was seen to be the most important characteristic of being successful in a mathematics classroom and was vocalized by every participant in the study. As seen with the parents, verbal encouragement was the most common form of encouragement, as described by six out of the nine interviewees. The verbal encouragement some of the participants received did not have to be recent for it to still resonate with the student. This is evident in the following quote from Sasha:

I remember in fourth grade that enrichment teacher (mentioned earlier in the interview) pulled me to the side and told me that I, like, only missed one question on the math EOG and how proud of me she was and how she could really see me going far, like, she can see my potential and to this day I still remember her saying that.

Sasha was in the fourth grade almost a decade ago, but she still recalled how having such a positive and encouraging teacher made her feel as if she was able to do anything she put her mind to in math. Along with verbal encouragement, Jackson and Tim also received awards given by their teacher and school. Jackson said:

Every year... we had this... award ceremony... and, like, each teacher had an award to give each student and teacher can only pick one student out of each class. So, one of my math teachers gave the award to me... I was really happy that the teacher was able to recognize what I was doing in class and, like, give me, like, a physical representation of how hard I have been working.

Being recognized with an award meant so much to Jackson because his hard work was recognized by someone whose opinion mattered to him. Jackson also appreciated receiving compliments from his teachers regarding his work and ideas. Tim found encouragement when

his teacher asked him to show how he worked out a problem, demonstrating that they believed he could do well in math, which is observed in the following quote:

... I could feel that they really believed that I could do well in math. Like, for an example, one time, we were, like, revisiting a concept from math 2 and Precal, and he said “Tim, get up and show us how to do this”. I was like... I really don't want to. He was like “Come one, you can do it” and then... he did it... and then he was like “ Tim. Is this what you do?” And I was like “Yeah, exactly”. So, I guess they knew they could do well, and it was really encouraging.

### *Teaching style*

Along with having an encouraging teacher, the teaching style of the instructor is also very important according to Tim, Tam, Sasha, Star, and Jackson. It is a challenge to teach a class with different learning styles, but the instructor should take time to get to learn what works well for the majority of their students, in addition to changing their approach of teaching to accommodate the different styles of learning. Both Tim and Tam preferred a teacher who had a methodological teaching style, meaning a teacher who had a rigid and well-organized style of teaching. Tam said, “... I think she was just... really good at, like, teaching. She was a nice person, but she was a great teacher. Her methods were great.” Star also appreciated a teacher who was well organized and had a class that was well structured. In one math course, Star had an instructor who she felt was not organized and said the following:

She didn't take good notes either. I went to, like, other Math teachers and I got notes... I feel like it's not structured, like, in a format that I can understand easily. That's the only time it negatively affects me.

When faced with a learning style that was not conducive to her learning, Star had a negative perception of how well she could perform in that particular mathematics course. Once her teacher adjusted her approach to teaching by adding more notes that did not just include practice

problems, Star felt more confident in her mathematical abilities. Another quote from Star that indicated how important the teaching style of an instructor is follows:

Math did not come easy to me. I just feel like when I was taught, and it was worded so well that I remembered it from my previous work.... like “oh, I remember this” and then we go over brief discovery, like “remember you learned this in” whatever math it was and then we'd elaborate on that.

Sasha also reiterated how teaching style is impactful on her success in a math course. She said, “I've stopped liking a subject because of teachers who I've had (which) definitely tells you that who I'm learning from can make an impact on what I like or what I enjoy.” Jackson said he liked it when his teacher “explains it well”, and Star appreciates having notes and recordings of the class. With whatever teaching style an instructor uses, it is important that students are able to ask questions, as suggested by Randy and Star, in order to clarify any misconceptions or confusion that arises. In addition to being able to ask questions, Randy also said that a teacher should present math in an exciting way and also present the rationale behind learning the concept, shown in the following quote:

I've always liked that for the majority of my teachers. They've... kind of presented math in a more exciting way. So, for me to understand mathematics better, I feel like I need to have a background for what the purpose is of what I'm doing.

Teaching in a way that is “exciting” to every individual would be a daunting task but trying to create a lesson that is of interest to most of the students would be greatly beneficial.

### *Teachers provide support*

The support teacher provided varied for each student but having support of some form was deemed crucial. The different types of support discussed were usually actions the teachers took, but they also included emotions shown and beliefs created on behalf of the students. The most common form of support provided by a teacher discussed in the interviews was offering

actual help with understanding concepts, as described by Alex, Randy, Sasha, Dee, Tam, and Star. Jackson said "... all the math teachers I had, had been really supportive of what I did..." and he went on to explain that the support he was referring to included getting help from his teacher and just having a teacher that was "nice." Dee went even further and described how she would often go to her teacher for help in saying:

Frequently, I visited this teacher in order to get help with math problems. They helped me and... She didn't get frustrated when I didn't know something, but she also wouldn't just give me the answer to something. I had to work for an answer even if it was wrong.

Another example of support given by teachers was showing multiple ways of solving problems and keeping an open mind when students shared approaches that varied from their own. Alex said "I'd say that a lot of them were, like, open-minded and, like, there for the students. So, they'd offer support, like, whenever needed and, like, they wouldn't make you, like, feel dumb for asking a question or anything like that." Trey talked about his teacher putting in "extra time" to help him with concepts he did not understand outside of class. He also mentioned how it was important that teachers care about the students and not just how well they do on standardized tests, which was reiterated by Randy, Sasha, Dee, Tam, and Star. Trey said "she, like, genuinely cared about us as students and that meant a lot to me." Star also had a similar experience and is quoted as saying:

I could come to her... she was open to, like, helping students whenever and, like, if you didn't catch something, she would try to like... she'd try to help you. ... She definitely doesn't want you to fail. She's going to be (do) everything she can to, like, help you out.

Providing review material before exams was a form of support according to Star, Trey, and Tam. Sasha, Randy, Tam, and Trey felt having a positive, or friendly, atmosphere in the classroom where everyone was made to feel comfortable was a way to support students. "... just being in that encouraging environment definitely made me feel more confident about math..."

was a quote from Sasha to show how the right environment made her feel supported to do well in her math course.

### **Peer Factors**

The peers which the participants mentioned are the other students that the participants went to school with and interacted with, whether in the classroom or outside of the classroom. It is noted that the peers discussed in the interviews came from different races, backgrounds, and ways of life.

#### *Peers that encourage*

Above all, having peers that are encouraging was something that was seen as very important to many of the participants. Giving compliments and simply indicating that the interviewees could do well in a math course were ways that their peers encouraged them. As seen with parents and teachers, verbal encouragement was the most common form of encouragement that peers provided. Eight out of the nine participants mentioned they received positive verbal encouragement from their peers. Star was the only participant who did not directly mention verbal encouragement from her peers, which was largely due to her desire to limit who she interacts with as the result of previous negative experiences with her peers. They said it simply, “a little encouraging word can really go a long way” when referring to the encouragement he received from his peers. Randy was a little more specific and actually repeated some of the comments his peers made. He said “I would always be told that “Wow! You're so smart” whenever I answer a problem correctly or “You're a junior in Calculus? Wow, you are really doing something”.” Dee also had a similar experience shown by the following quote “My peers used to call me the smartest person in the school/grade! I would help tutor

students who needed help with different subjects and get paid when their grade came back higher than ever... .”

Tim and Trey had peers that encouraged them to participate in class discussions. Tim described one experience as the following, “I’m in like a small group or a pod and they’re like “Tim, go up and do the problem on the board” or “answer the question... raise your hand” .” One-way Tam felt encouraged by her peers was by the fact they “... never made me feel stupid at all. They just told me about it... taught it to me. Made sure I was on board... I never felt inferior by anyone.”

### *Comparing themselves to others*

Comparing themselves to others, typically through friendly competition, was another recurring theme between the participants and their peers. Tim said:

... in my friend groups throughout school, even though they’ve changed I’ve always felt like they were supportive of me academically and occasionally, like, have some rivalries with my friends to see who can do the best. I guess we pushed each other to do better academically.

Alex and Trey also had similar experiences where they competed with their friends to see who could perform better on an assessment, or in a class in general. Trey and Star, who are self-proclaimed “competitive” people, also noticed the benefit of a friendly competition. In the following quote, Trey speaks on his experience at his current high school and previous high school and how the type of friendly competition he partook in changed. Trey said:

I’m a really competitive person... I’m like super competitive... we would, like, see who knew the answer to the question before the teacher even like finished asking it. ... Then at XXXXX, like I said, I had that one really good friend... and we would always compete and would always see who was, like, “can I get the question right” and that kind of thing.

Four out of the nine participants spoke on comparing their overall success in a mathematics class to the success of their peers. Jackson and Sasha looked at their grades in particular. At

Jackson's old school, they always compared grades, but at his current school, students are more sensitive about their grades and are not as willing to share. He said:

... Definitely it was more powerful in my old high school, like, nobody cared though. Like this is my grade whether I failed or not. ... I would always show my grade and they were like "Woo Jackson!". It was always a thing that we always, like, look at each (others) grades. ... It's definitely less prevalent at XXXXX. I feel like a lot more students are sensitive about what grades they make cuz they hold themselves up to such a higher standard and I feel like they probably wouldn't want to, like, compare their grade to another grade and like they're lowering (their grades are lower than their peers).

#### *Peers that are willing to help/work together*

It was common for the participants to need help with their work or their understanding of more challenging concepts, therefore having peers that were willing to help them with their work was seen as a necessity. Jackson, Trey, Sasha, and Star spoke on the ability for peers to "struggle together" and how the act of struggling created a bond between them. It was the notion that they faced a challenge and were able to work together to overcome it that created the closeness and willingness to work together to tackle obstacles. Trey spoke about a time in his Precalculus class when he studied with a peer in order to prepare for his test. Trey said:

... I had a really good friend. She was, like, training to be a math tutor... and she was also in Precal and she was like, "hey we need to study" and I was like, "you know what? Yeah, I think I would definitely love to get in some studying" and so we studied. We, like, studied-studied.

Trey went on to mention that he did so well on the exam that he was able to pull his grade up to an A after being on the border of receiving a B. Having peers that are willing to help and tutor the interviewees was also seen as significant by four of the participants. Tam said:

Without her, I definitely wouldn't have done as well as I did... not only did she, like, help me, (she) basically tutored me with her notes from her previous class. She was always there encouraging... she would always remember if I had a quiz or test, she'd always ask me, "Hey, how'd it go? How do you feel?" And if I felt bad about it, she was just there.

This represents the interactions Tam had with a peer who went above and beyond to help her be successful in her math course. Not all peers are willing to go to the same level to help, but it was refreshing to see at least one instance where a peer of a completely different background was so invested in the success of an African-American student. Another quote from Tam that emphasizes the same sentiment is the following:

Being able to collaborate with my peers in mathematics is very important and it's always been very important, but I feel like coming to (her current school) has been easier because everyone's going through the same thing... and we are competing against each other but there's always a sense of togetherness. So, whenever I ask for help for something, or I didn't understand... there would always be someone who's willing to help me who wasn't a teacher...

Even Star, who was very selective in who she interacted with, mentioned that having the support from her peers was helpful. She said “We help each other out. If I miss a day, they'll take notes for me.”

### **Self-Factors**

There are many factors that can contribute to an individual's success, or lack thereof, in mathematics, but one of the more difficult to investigate are the factors that come from the individual themselves because they can only be established by talking to the individuals. However, self-factors are one of the results that I was able to report since I'm focusing on the participants own words. “Self-factors” are difficult to examine because there are still outside influences that have some form of impact on the individual and distinguishing them from personal ideas can become nebulous. In this section, I discuss what the participants actually talk about as their own personal characteristics that help them be successful in mathematics.

### *Understanding concepts*

Having an understanding of the concepts they are learning appeared to be the number one factor for students expressing positive self-efficacy in mathematics. Alex, Tim, and Randy all spoke of their ability to grasp concepts, which made them believe they were able to understand the math concepts they were covering. Alex said, “I feel like generally, I’m able to, like, grasp the concepts of what’s, like, being taught and, like, follow along with the, like, work and all that and, like, tests.” Alex also spoke on her ability to eventually have a higher understanding than others, even if she was behind initially. She said:

This past year, I was switched between, like, three different math classes. So the third one that I was in I was a little bit behind but I was able to catch up and even, like, surpass the material that had been taught, so that was a real, like, big moment for me.

Dee said she knew she understood the concepts covered in her mathematics course better when her grades started to improve. “...my grade slowly started going up. She [her teacher] made me realize that I could always count on her for help and that math wouldn’t be so confusing if I just got help when needed.” This quote shows how understanding concepts could still be connected to outside forces that helped the students understand. Seven out of the nine participants used EOG scores and exam grades as an indicator of their understanding of concepts. If they received “good grades” on their assessment, they took it as a sign that they had a solid understanding, whereas a “bad grade” meant they needed to work harder to grasp the concepts.

### *Motivating self*

Regardless of those around them, a few individuals motivated themselves to be successful in mathematics. Tam was especially expressive in her ability to turn negative comments to her advantage. In reference to negative comments Tam said:

If they're negative, I use them to, like, I turn them to (a) positive. I use them to push myself harder. If they're positive, I use that to push myself harder, you know. Anything, any views, anything at all, it's going to be converted into positive energy...

Jackson, Trey, Randy, Tam, and Star all spoke on the need and desire to try harder and to “put in hard work” in order to do well in mathematics. Trey, Sasha, Dee, and Tam mentioned that they were “driven” and had “self-determination”, therefore they were willing to put in the time and effort needed to do well in their mathematics courses. Trey said:

I have a pretty clear vision of where I want to go, and I know what it takes to get there. So, I know I'm going to have to work hard. I truly believe that I'm so much more capable than I was giving myself credit for so, like I said, it may not be easy, it may not come to me like that, but that doesn't mean I can't do it.

Randy also mentioned that he had his career goal in mind, so he would do whatever it takes to achieve his dreams. One of his goals was to get better grades, but to also major in the field of his desire once he is in college. Sasha and Tam both suggested that “exceeding the expectations of others” was their motivation to do well in mathematics. In true Star fashion, Star said:

I could say that outside influences for me have a minimal impact because I don't care what other people say. I don't care what they think. I'm just going to do what I need to do in order to do well in this class.

### *Having a positive outlook*

Having a positive outlook on what they have accomplished and never giving up regardless of the obstacles they face was the last theme found within self-factors. Tim expressed on many occasions that he has “always been performing pretty well” in mathematics and added that he always remained positive when starting a new math course. He said:

I think I could do pretty well in most course(s), even if, like, some people say that they're going to be challenging. I usually don't let that deter me from trying to do well. I usually don't go into a math class thinking I'm going to do poorly.

Jackson, Tam, and Star simply said “I knew it” to show how they positively viewed their abilities in math. In a shocking recollection of events, Tam spoke about her experience freshman year when she was taking Math I and had an inadequate teacher. She mentioned that her teacher did not actually teach her class math but preferred to discuss his relationship with his ex-wife and other non-math related topics. Instead of giving up in despair about not having the foundation she needed in a fundamental math course, Tam remained positive and taught herself what she needed to know. Tam said:

The fact that I was able to pull off a 4... (when) I was really expected to fail that EOC... No one did that but me and I definitely felt, like, invincible at that moment, you know, even though the year was not the best it definitely was the best for math because I proved to myself I could do anything, literally anything.

### **Negative Factors**

Unfortunately, not all interactions and experiences of the participants were positive. There were a few instances that proved to be detrimental to the self-efficacy and beliefs of the students. Instead of focusing on the negative aspects for each of the factors mentioned above, each negative factor will be put into three categories while examining how each of the factors may, or may not, be represented in the negative factor categories.

#### *Not understanding concepts*

The lack of understanding caused by their own misconceptions and created by those around them was the main contributing factor for causing the participants to doubt and have a negative attitude towards their abilities in mathematics. Surprisingly, there were times when the teachers did not understand the content which caused the students to doubt their understanding. Jackson recalled a time when he asked his teacher for help and she was unable to help him solve the problem. He said:

This is like one particular problem that I didn't understand and so I showed it to... her and she spent like, it felt like 20 minutes trying to figure out this one problem. I was like... what's going on here? And so, she spent a long time trying to figure it out and... she didn't figure it out. And she said like “we're just going to have to talk about this later”. And so, I spent like twenty / thirty minutes sitting in her room watching her figure out a problem and she didn't figure it out and then I had to go... home still not having the problem answered and still confused. So that was very frustrating.

Having spent so much time and still not knowing the answer because the teacher did not know the answer was very discouraging for Jackson. Sasha mentioned a similar experience where the student teacher did not know the math concepts she was presenting, and her actual teacher was powerless in helping the students understand until the student teacher was finished with their practicum. With the lack of understanding, Jackson and Dee said they felt “dumb” and unable to do well in the math course. Jackson had a moment of self-reflection as to why he did not understand the concepts covered. Jackson said during the interview:

I still don't think my confidence is where it was before only because I think I'm surrounded by people that would understand the concepts better than me and it makes me feel like I should be understanding at the rate that they're understanding it... (it) just makes me feel like I should know... why don't I get it yet?

This demonstrates a time that Jackson not only did not understand what was going on in the class, but his confidence also took a hit. Having moments when their confidence was not up to par was echoed by Star and Sasha. Sasha is quoted as saying:

I think I really lost hope in myself when it came to the transition between sophomore and junior year... (I) had to retake precalculus because I was like... “oh if I didn't do well then and I have to retake this class again, maybe I'm not good enough for Math” and the fact that I had never had to retake one class, let alone two, I think, junior year I know did a little bit to my mental health and my confidence when it came to doing well in math. So definitely, it's been downhill. Yeah. Yeah. I'm like Flatline now, but as I got older during my school experience (my confidence) definitely went down.

In mathematics, there are moments where confidence in the student's ability to do well in the course will fluctuate but having prolonged periods of low confidence can be detrimental in the long run.

### *Lack of support*

Though not as common, having a lack of support was also a reason for concern and negative self-efficacy. The lack of support discovered in the interview came from teachers, as well as peers. Tam felt a math instructor she had did not support her because they were insensitive to the needs of the minority students. Tam said:

... a lot them they don't mean to be racially insensitive at times but they can be and... they think they're joking but... some things that they say is not okay... when a student would make like a comment like that, maybe she (the math teacher) looks over it, you know and like brushed (it off). She would never make a comment like that. She was very accepting and I think she knew herself not to do that, but I think what I would want a little bit more from her during my eighth-grade year (and) would be to go as far as telling another student, "Don't say that", you know. Like, a lot of the white teachers at school could have done more to stop other students. They themselves were fine, but, like, they definitely could use their authority to do that better.

Having a teacher that does not vocally stop other students from speaking down to students of color would create an environment where minority students do not feel supported or cared for. Dee mentioned a situation where her teacher simply gave up on her and her classmates. This situation is discussed in the following quote from Dee:

A lot of my teachers seemed like they gave up on some of the students, or all of us. We were bad students sometimes but that is because they wouldn't try to build an actual connection with us. When you see someone give up on you, you could either give up on your end too or continue to push like I did.

There were other instances where the interviewees did not feel supported by their teacher because they did not change their teacher style to try to accommodate the students' learning style, or the teacher simply did not teach at all. Randy was noted as having the most occurrences

where he felt unsupported by his instructors. He did not feel as if they understood him, the student, as a person and he simply did not feel supported in general. Randy said:

... There was no way for me to prove that my teacher actually felt that way, but it definitely did feel that way coming from where I was. ... She was a good teacher in my eyes, but I feel like she would never call on me to answer questions. She would never really kind of help me stay engaged in class and then I feel like she would single me out sometimes and make me feel less than whenever I did get the chance to respond, which was very rarely and then I didn't feel like I really had a relationship with the teacher as other students did. ... I kind of came to class listened to a lecture and then left. ... You don't feel like it's blatant racism, but you feel like... "I understand that you're black, but I don't want anything to do with you.

There was another quote from Randy that reiterated his lack of support from his teacher:

So, it felt like the teacher did not really care about how I did in the class, and so she kind of just taught and... if I would ask a question she kind of reluctantly respond(ed) to it or if she would. Sometimes in some cases she would refuse to answer questions from students.

At times, Randy seemed to feel as if his peers also did not support him as well. Out of the nine participants, he was the only one who stated that he did not "feel supported by peers" on more than one occasion. There were times when Randy needed help and his peers would not help him when asked. Randy mentioned that those peers were not of the same background as him, but that does not necessarily mean there is a direct correlation between their race and not wanting to help him. There were many times when Randy felt excluded from his peers. Randy said:

There weren't a lot of black people in my classes or really even in... classes above Precal. ... I kind of felt excluded from those groups who would share homework with each other, kind of share understanding, (and) study together. So I felt excluded from those groups and then also, I feel like a lot of times I wouldn't be asked for help as much as other people would be like at, say at my pod, and although it may (not) have been because I was black it very well seemed that way. ... People just assuming that I can't be of help to them or be a benefit to them because of my skin tone.

### *Negative interactions*

Eight out of the nine participants experienced some form of negative interactions with their teachers. Alex, Trey, Tam, and Jackson spoke of times when they had a teacher who doubted their abilities and capabilities in mathematics. The teachers did not expect much from the minority students they taught. Trey mentioned his Math 3 teacher who “didn’t believe in our capabilities just because of our color.” Trey took that negative experience and made it positive by having the attitude “I’m black but I’m just as capable as your white students, so don’t ever doubt my capabilities.” It was shameful to learn that three of the interviewees experienced outright rude and mean comments or actions from their teachers. Star said “I don’t know why she was so rude. I hated it and it wasn’t just me. She was like that to everybody. Maybe she just didn’t like her job, but it was like I don’t appreciate this treatment.”

Understandably, negative experiences will affect how students view math at the moment, an idea suggested by both Sasha and Star. In examining the negative experiences students had with their teachers, it is challenging to determine whether the treatment comes from disliking students because of their race, or if the teachers are rude regardless of who they interact with. Randy was one student who felt strongly that he was treated differently by his teacher when compared to the non-black students. In the interview, he described the following experience in the classroom:

... back to my eighth-grade year. So, it felt like the teacher did not really care about how I did in the class. And so, she kind of just um taught and... if I would ask a question, she kind of reluctantly responded to it or if she would. Sometimes in some cases she would refuse to answer questions from students.... and I felt even more that way because I was black and... I didn’t connect (with) my teacher as much as the other white kids did...

As with the teachers, there were times that participants had negative experiences with their peers. Alex, Sasha, and Dee spoke about occasions where their peers spoke to them in a condescending manner. Alex said:

Yeah, because in the course where I was, like, not doing as well, the (other) students were kind of like, kind of condescending towards me. I became, like, more quiet in the class and wouldn't, like, participate as much to avoid, like, negative comments.

Alex and Randy both talked about the negative comments they overheard from their peers, especially if they answered a question incorrectly, regardless of how many times they had answered questions correctly. Randy and Sasha's peers assumed they would not benefit from their ideas and would not listen to them. There were also cases of non-friendly competition where Randy and Sasha's peers delighted in them not doing as well.

Finally, only one participant indicated they had negative experiences with their parents when it came to mathematics. Star's mother said that she was overly dramatic when she received a bad grade on her math assessment. "If you show tears, my mom will tell you in a second, if you show tears, you're small. That's what my mom says." Star's mom may have meant it as a way to uplift Star and make sure she did not succumb to negativity as the result of one disappointing incident, but Star did not interpret the saying in the same way. Star took it as her mom telling her to stop whining and that she was expected to do well in her math classes.

To end this chapter, I want to highlight two thoughts: the two-parent household, homeowner parents and the connection to Critical Race Theory. One important finding that might need mitigation is that many of the participants in the study came from two-parent households and their parents owned their home. To some, this may incorrectly imply that in order for African-American students to be successful in mathematics, they must come from a two-parent home and their parents must be able to own their home. This is not what the research

is trying to suggest by any means, it just so happens that the majority of the participants had similar living situations. There was a participant who completed the survey that did not come from a two-parent home and her parents did not own a house, however, she has done very well in mathematics in terms of her grades and was able to complete AP Calculus AB while still in high school. Ideally, more participants would come from a more diverse living arrangement, but I was unable to persuade such students to participate in the study.

Finally, Critical Race Theory in education looks at white privilege and the prominence of racism, and these two components were clearly seen in how African-American students were treated differently than non-African-American students by teachers and peers. This treatment was often negative and tended to have a negative impact on the belief and feelings of the African-American students, even if only momentarily. Critical Race Theory suggests that these differences create inequalities, and this could be seen when the students did not feel supported by their teachers and peers and therefore their self-efficacy was negatively impacted.

## Chapter 7: Discussion and Conclusion

This final chapter consists of four components. First, I answer the research questions as presented in Chapter 1 and 3. Because the strength of this work is that it is from the student perspective, I am going to answer these questions in a vignette as told by Eugene, who is a made-up student that represents the collective voices of the African-American students from this study. Vignettes are “short stories about a hypothetical person, presented to participants during qualitative research” (Gourlay, Mshana, Birdthistle, Bulugu, Zaba, & Urassa, 2014); in this case the hypothetical student is telling the short story. Since this is an instrumental case study, I looked at the case of successful African-American students to answer the research questions, but I believe the answers to the research questions can be generalized. After the research questions are answered, I will discuss some of the connections between my work and already published research in this area, talk about implications of the study, and spend some time tying it all together in a conclusion. Here are the research questions that Eugene will “discuss”.

1. What personal and environmental factors influence the success of African-American high school students in mathematics?
  - a. What impact does parental interaction have on the success of African-American students in mathematics?
  - b. What impact does family interaction, particularly extended family interaction, have on the success of African-American students in mathematics?
  - c. How do interactions with instructors impact the success of African-American students in mathematics?
  - d. What role does peer interaction play on the success of African-American students in mathematics?

- e. How does socio-economic status influence African-American students being successful in mathematics?
  - f. What other environmental factors may affect African-American high school students' success in mathematics?
2. How is self-efficacy related to success and the environmental factors mentioned previously?

### **Eugene's Narrative**

Hey, everybody! My name is Eugene and I am so excited to talk to y'all today about my experience in mathematics as an African-American male. The first thing you should know about me is that I am pretty close to my family, especially my parents and my older brother. I can honestly say that I would not be the man I am today without their support and guidance. That being said, my parents have been instrumental in my success in mathematics from the very beginning.

*(RQ1)* I would say things that have influenced my success in mathematics would most definitely be my parents, followed by my teachers. I have had some pretty awesome classmates over the years, so I think they have also had some influence on what I've been able to accomplish in math.

Overall, my parents have had the most influence on my success in math because they have always been there. From elementary school, all the way up until now, my parents have encouraged me and supported me in math, but of course, in all of my classes. I know my peers may not say the exact same thing for what affects their success in mathematics, but I am confident we would have some things in common. I think it would be pretty common to see parents, or other family members, teachers, and peers on the list because those are the people we

are around the most. I would also say that I, myself personally, play a large role in how well I've been able to do in mathematics. I think this is true for me as well as many of my friends. Later, I will explain how my parents, teachers, and peers affect how well I do in math classes and how I feel about math overall.

Some people wonder if where I live has an impact on my success in math, and I would have to say, no. I live in a rural area and compared to areas around us, we do not have as much funding for fancy equipment in the classrooms or any of the advanced technology I hear other schools have. To me, that doesn't mean I can't be successful in math because I am living proof that you can still do well in math with limited resources. Like I said, where I live, in my opinion, doesn't have much to do with anything, and neither does my parents' education. My other friends feel the same way. My friend Monique's mom and dad both have their master's degree and she does well in math, but my mom only has a high school diploma and my dad has a bachelor's degree, and I do just as well in math as Monique. I don't think any of my black friends would say how far their parents went in school really impacted how well they do in math. For most of my friends, at least one of their parents have a bachelor's degree. At the end of the day, if I really want it, I'm going to go out and get it and do whatever it takes. I know this goes against the stereotype that black males are lazy and always looking for an easy way out, but I don't mind working hard for what I want.

*(RQ1a.)* As I said before, my parents have a huge impact on my success in mathematics. They have always been there for me in any way that they can. I can remember in elementary school my parents would help me with my homework as often as their schedule would let them. Once I got into middle school and took Math I, they didn't help me as often because they didn't understand the material as well. If we had extra money, they would hire a

tutor to help me, but that didn't happen very often. Even when they couldn't help me study for a test or help me with my homework, my parents are always there encouraging me to do my best and giving me uplifting words.

Of course, my mom and dad encourage me in slightly different ways. My mom is very nurturing, while my dad is pretty factual. He just wants me to do my best and to do even better than he did in school. I can always call them for moral support or when I am feeling down about not doing well on something. When I am feeling down though, I am more likely to talk to my mom because she just says the right things. I was talking to my friend Jackie the other day and she was telling me about how she really appreciates the fact that her parents believe she can do well in any math class she takes. Like my parents, they give her words of encouragement and make her feel better about herself. My friend Christine would say she experiences the opposite. Her mom is not very gentle when it comes to making her feel better when she doesn't do as well on math assessments as she would like. It is sad to think that the one person you think would normally be so caring is not as supportive as Christine wants.

My mom and dad are no longer able to help me with my math homework, but that's cool! Even if they haven't taken BC Calculus, it doesn't matter because they are still there, literally sitting at the table with me, trying to help me figure it out. I would tell all African-American parents that it's okay if they don't fully understand what their kid is doing in math, or if they never even took that class. The most important thing is for them to be there emotionally and mentally. That's all that really matters. Knowing that your parent's have your back through thick and thin. I think overall, other African-American peers I know that are doing well in mathematics have a similar experience to me. Their parents may not know the material they are learning, but they still support and encourage them in their own way. I know Lamont's mom

still helps him with his math work, but she majored in economics and had to take more math courses. It's great that she can still help him, but that isn't very common.

*(RQ1b)*. I am fortunate to have the greatest big brother anyone could ever ask for! He is four years older than me, but he has always been so supportive of me and everything I want to accomplish. Since we are kinda close in age he felt it was his job to teach me everything he had learned in school. At first, I thought it was really annoying and just another way of him trying to tell me what to do, but then I realized what he was teaching me actually helped. One tool my brother taught me to use in math was flashcards. Like, every time I learned a new topic in math, he would make me put it on a flash card. I had formulas on flashcards. I had multiplication tables on flash cards. Math definitions. You name it, and I'm sure I had it on a flash card. We used to have a friendly rivalry growing up about who could get the best grade in their math class, both that competition really pushed me to always try my best at an early age.

My brother not only helps me with my homework, but he encourages me too. Like my parents, he told me that he knew I could do it and that I was more than capable of doing a good job in my math classes. He also is there just to listen and give me advice. He has already been where I am trying to go, so he knows what I am going through as far as being an African-American male in higher level math classes. A lot of my friends have older brothers and sisters too, and most of them are supportive. My friends Netta and Brian have younger brothers and sisters, so they are the ones that end up helping their younger siblings, just like my brother does for me.

Not all of my peers have the support of their extended family simply because they do not live in the same area. Even though my friends Netta and Jackie both have family members that live near them, they are just not as invested in how they are doing as my family members are. In

my family, my parents have taught us that one person is a representation of the entire family, so we try our best to represent the family well. When I talked to Christine the other day, she said something similar. It is common knowledge that you never do anything to embarrass your family, so for me, that means getting good grades in math, and all of my classes actually, and staying on top of my game.

*(RQ1c)*. Like I mentioned earlier, my parents have helped me become successful in math, but so have my teachers. I have had some pretty awesome teachers over the years, and I think I do so well in math because of them. Yeah, I have had some not so great teachers, but I think the good ones definitely outweigh the bad ones. Teachers may not realize it, but, let me tell you, they have a major impact on how well African-American students do in a math course. Our interactions with our teachers are pretty special. I believe that having a teacher that is nice is pretty crucial, and my friends Jackie and Brian believe the same thing. What do I mean by nice, you ask? Nice to me is a teacher who doesn't fuss at the class because we don't understand a concept right away, or maybe a teacher who tries to be positive and uplifting regardless of what is going on. I remember one time that I got my grade back from a midterm and I did horrible! Right in the middle of class I had a total meltdown. My teacher didn't ignore me, but she took me to her office, and we talked about what I did wrong and how I could do better on the next test. That meant a lot to me. Another teacher I had just kept saying to me, "You got this. I know you can do it." It wasn't all deep and emotional, but it still meant something to me and made me feel better about my abilities in math. Also, I don't expect a teacher that smiles every single moment of the day, but not frowning or yelling all the time would be appreciated.

It is also important for me that my teacher is supportive and gives me extra help when needed. I understand that my teacher has a life outside of my school but being able to receive

extra practice or spending a little more time going over challenging concepts would be great. Having a teacher that cares about me as a person is also very important. I am more than just a grade! I know a lot of teachers face pressure from the “powers that be” to make sure their students perform well on state mandated tests, but we are more than just a number.

You know that I now go to a specialized school that is for students who are identified as academically strong, but I come from an underfunded district where my teachers did try to teach us something, and they didn’t just gossip all day. I think a math teacher should actually teach their students math. I get that some concepts stick better with self-discovery, but students shouldn’t have to discover the big picture every single time. That puts a lot of pressure on us, and it makes things difficult if we have to relearn what we discovered because what we thought initially was incorrect.

Finally, the most important thing a teacher can do to help African-Americans students be successful in mathematics is leave their idea that African-Americans are not as good at math as whites at the door. I know it may be hard to do, especially if they had negative past experiences, but for the sake of the current students, leave it at the door. Teachers should treat everyone with respect and give them a chance to prove themselves. Teachers should treat all students the same, regardless of their race. My peers Jackie, Christine, and Brian would agree whole-heartedly with that. I would tell any teacher not to doubt my abilities because I am black. If they doubt what I can do in mathematics simply because of my race, I will try to prove them wrong every time.

*(RQ1d)*. When it comes to getting good grades in math, it is the best to have classmates that support you and try to encourage you. Having someone to help you with stuff you are struggling with or having a study partner is pretty important. It is great bouncing ideas off of each other and having someone to vent to that knows what you are going through. It really

helps. Brian, Christine, and Jackie all have similar views when it comes to the benefit of having supportive peers. They all mentioned that at times they were able to do well in a math class because their peers took the time to work with them and help them understand concepts. I experienced that firsthand during junior year when I really wanted an A in Precalculus, and I relied on my friend to help me study. If it were not for her, I may not have been able to pull it off. My friend Lamont doesn't rely on his peers as much as the rest of us because he has always worked mainly by himself, but that is not to say he does not benefit from working with his peers.

Of course, even in this day and age, I still have encountered peers that don't support me simply because I am black. They look down on me and don't think what I have to say has any value. It is sad really. Christine and Monique had similar experiences. It is a double whammy for them because they are black and female. A lot of our peers are white males, so being a black female in an advanced math course must be really challenging for them. Lamont also had a lot of negative experiences with peers who looked down on him because of his skin color. That was pretty detrimental to Lamont's self-efficacy because the negative comments from his peers made him second guess his abilities in math. Though I also have experienced those negative peers, I try not to let them get me down. Really, I try to avoid anyone who is not positive and uplifting. I don't have time for the negativity.

*(RQ1e)* I personally do not think how much money my parents have influences how successful I am in mathematics. According to some, my family would be considered middle class because we own our home and my dad has a bachelor's degree, but I have friends who would not be considered middle class, and they still do pretty well in math. To me, how much money someone has may have an impact on whether or not they can afford private tutors for math and things like that, but usually, students can always get extra help from their teachers.

Most of my peers at my current school are considered middle class, so I don't have much knowledge outside of that. I do know one girl, Cassie, whose family doesn't have a lot of money and may not be middle class, but she still does really well in math. That's why I don't think how much money a family has, has that much influence on how successful African-American students are in math.

*(RQ1e)* If I had to think of other stuff that may affect how well African-American students do in a math class, I would say possibly who else lives in their house. With it just being my parents and my brother at the house, I have always had a quiet and distraction free place to study. That may not be the case for everyone. If they have younger siblings running around, or cousins, aunts, uncles, or grandparents, the house could be crowded and loud more often, making it difficult to study. Of course, everyone's situation is different, but that is one other thing that could affect success. I am sure there are more, but those are the only ones that come to mind right now.

*(RQ2)* Before this interview, I had never heard of the word "self-efficacy", but after it was explained to me what it means, I think I have a better understanding of how it could relate to my success in math. So, to my understanding, self-efficacy is how well I believe I can do in a class, but with a focus on math classes for this project. It sorta reminds me of how I would rate my confidence in math, which I have to admit is pretty high! I think my self-efficacy could be related to success, but it doesn't have to be since at the end of the day it really could depend on a lot of other things. Personally, I think that how I feel about my abilities to do well in a math class and how I actually do in the math class are related in some way, but how I feel doesn't automatically determine how well I will do in a math class. I have to take into account the topics

covered, how well my teacher actually teaches, and many other factors that may be going on in my life during that time.

I have to admit, there have been some topics that I have learned in math that were just really hard at first. I mean, I studied, and I paid attention in class, but it just took me a minute to understand what was going on. I would definitely say learning about trigonometric functions and derivatives were by far the most challenging things I have ever done in math. When I failed my trigonometry test, my self-efficacy was pretty low. I did not think I would ever learn trig, but eventually, I got the hang of it. That was one time where my self-efficacy did not have an impact on my success in the class. Even though my self-efficacy was negative at the time, I was still able to do well in the class and managed to get an A. There was another time when I was really confident in what I knew but did not do very well on the test. When I had my related rates test, I had studied every night and I thought I knew what was going on in class. I just knew I would get an A+ on the test, but to my surprise, I barely managed to get a C. This time, my self-efficacy was positive, but I did not do well on my test. That's what I mean by how I feel I will do in a class doesn't mean I will do good or not.

Besides the topic I am learning, how I do in a class depends a lot on how the teacher teaches. If my teacher doesn't explain the topic well or gives me example problems, I probably won't do well, even if I think I should be able to. It is important to me that my teacher explains things and takes the time to make sure that I actually understand. If they barely cover what I am supposed to learn, it doesn't matter how confident I am, I will struggle on the test.

In my opinion, self-efficacy is definitely related to the other environmental factors mentioned previously. I am a firm believer that self-efficacy can be shaped and driven by those around you, be it family members, teachers, or peers. Overall, my peers would agree with me,

except maybe Jackie, who is one of the most self-motivated individuals I have ever met. She is a firm believer that if she really wants something, she will move mountains to get it. I feel the same way, but I also recognize that even if I don't want them to, other people around me can, and do, change how I feel about myself. That is why it is so important to surround yourself with positive and uplifting people. I don't need a "negative Nancy" bringing down my vibe. I can do without that.

Thanks for asking me about what I think about how well I do in math and how I've been successful in it. I hope you heard how hard I work in math, and how much help family and teachers have been for me. I can't wait to go on to college where I will major in computer programming and eventually become a software developer. I hope to one day start my own technology company and develop innovative programs to change the world. That is definitely my ultimate goal!

## **Discussion**

In general, the results from this study provided confirmation of the findings from previous research, but I add more from my results in hopes of explaining the "why" behind some of the earlier findings. The most important findings discovered from this study were that the parents and teachers of African-American students who are classified as successful in mathematics are supportive of them and there is some connection between self-efficacy and success for African-Americans in math. In the next paragraphs, I review what is already found in research and then confirm, enhance, or contradict it.

Previous research had shown that there were numerous factors that have been identified as contributing to the success of African-American students in mathematics, and among those factors was a supportive family (Terenzini et. Al, 1994; Gainor & Lent, 1998; Gutman, 2006). A

supportive family included the parents foremost, but it can also include siblings, grandparents, and other extended family members (Terenzini et.al, 1994; Gainor & Lent, 1998; Gutman, 2006). Verbal support and helping students with their math work were two of the forms of support that parents provided African-American students (Martin, 2000). The verbal support included parents expressing to their children the importance of mathematics, as well as words of encouragement (Martin, 2000). Under verbal support, parental belief regarding how well they believed their child could perform in a math course was also linked to the students' success in mathematics (Wu & Qi, 2006). The performance of students was directly linked to their parents positively recognizing their ability to be successful in mathematics just as earlier work had reported (Halle et al., 1997; Moody, 2000; Sheldon & Epstein, 2005, Wu & Qi, 2005).

In this study, I also found that students responded positively to parents that believed in their ability to do well in a mathematics course. Parents that provided verbal encouragement helped their child believe in themselves and ultimately perform well in the course. In addition to positive beliefs, providing students with words of encouragement was also found to be vital. Parents did not have to become superfluous in their encouraging words, but simply telling their child "I know you can do it" went a long way. Even though previous research indicated having parents that were able to help their child with their math work was important, that was not necessarily the case in this study. With only one participant who had a parent that could help them with their math work, the other participants still did well in mathematics. It was often mentioned that it had been years since their parents were able to assist them, but it did not matter, because to the students it was more important that their parents provided words of encouragement and acknowledgement of their achievements.

In addition to verbal support, parents were also found to provide moral and emotional support to the participants. Having parents that were willing to listen to the good and bad helped the students feel more supported and that their parents truly cared about their well-being academically, but also emotionally. Overall, the participants recognized that their parents expected them to perform to the best of their abilities in mathematics, but even when they did not, they still had their parents there to provide whatever support they needed to overcome the stumbling block.

The role of the teacher in the success of African-American students has proven to be vital in previous research (Treisman, 1992; Gainor & Lent, 1998). In the studies of successful African-American students in mathematics, many of them attributed their success to having strong connections with their mathematics instructor, who had a warm, and caring disposition towards them (Borman & Overman, 2004; Moody, 2000; Seyfried, 1998; Taba & Elkins, 1966; Walker & McCoy, 1997). African-American students that had teachers who cared about them and their abilities to succeed were more likely to do well in mathematics (Gainor & Lent, 1998). As seen with the parents, teachers were shown to also provide support for African-American students, which typically came in the form of validating their responses to questions asked during class and having them show their work to solve problems (Gainor & Lent, 1998). Possibly without even realizing it, teachers were found to have a strong impact on the self-efficacy, beliefs, and achievement of African-American students in mathematics (Walker & McCoy, 1997). Some studies have found that teachers are the most instrumental in the success of African-American students in mathematics (Gainor & Lent, 1998).

I found that even though teachers are very important when it comes to the success of African-American students, they are not necessarily the most important element in the eyes of

the students. For some students who may not have the support of their parents in the way they want, the support from their teacher is vital, but when students believe their parents “have their back”, the relevancy of the teacher being supportive and encouraging to the student wanes. As was found in previous research, it was important to students that their teacher validate what they have to say in class and ask them to contribute to class discussions. Having a teacher that cared about the students beyond their academic success was also found to be significant, but the participants did not suggest that their relationship with their teacher directly influenced their success.

The participants were explicit in what type of support they found to be helpful from teachers. Providing additional practice problems and help with challenging concepts outside of class were seen as crucial forms of support. Also, treating African-American students the same as Caucasian students was an important underlying element that many of the participants noted. Similar to previous research, it was important for students that their teachers tried to form a positive relationship with them inside and outside of the classroom. Being that the teacher should have control of the classroom, having an environment that is inviting and students of all backgrounds feel comfortable is another way the participants thought that teachers can support their students. Finally, this study found that teachers should not allow students to speak negatively about their abilities but should encourage them and uplift their beliefs as much as possible, which leads into the next factor of self-efficacy and how it impacts success.

Previous research has shown that there is some connection between positive self-efficacy and success in mathematics. Positive self-efficacy from validating experiences were found to lead to the success of African-American students in mathematics (Gainor & Lent, 1998; Gutman, 2006). With positive self-efficacy, regardless of negative comments from parents, teachers, or

peers, African-American students were able to succeed in their math courses (Fullilove & Treisman, 1990). It was found in earlier studies that stereotypical gender roles influenced the success of females in mathematics and starting as early as elementary school, female students were found to allow the math anxiety of other students to negatively affect their views of mathematics (Spencer, Steele, & Quinn, 1999).

In this study, it was fascinating to find that just because the concepts become increasingly difficult did not mean that the self-efficacy of the African-American students decreased or became negative, which was suggested by Martin's study (Martin, 2000). There did appear to be some relationship between self-efficacy and how the participants viewed the success of their peers. There were students who had positive self-efficacy and performed well in their course, but there were also participants who had negative self-efficacy, but they also performed well in their advanced math course. The previous research would suggest that when a student does not believe they can do well in a math course, they will not, but that was not found to be true here. It was noted, however, that the majority of the participants did believe that how they felt about their ability to do well in their math class did impact their success in some way.

I also found that both male and female participants had positive and negative self-efficacy, with not much difference between the two. Overall, the participants in the study had positive self-efficacy, but there were a few cases where negative experiences with teachers or low grades on assessments caused the participants to doubt how well they could do in an advanced math course.

Recall that Critical Race Theory was the theoretical framework on which the research was based, and its purpose is to analyze how social, economic, and legal differences between races are used to create racial inequalities that benefit the Caucasian population (DeCuir &

Dixson, 2004; Delgado & Stefancic, 2001; Ladson-Billings & Tate, 1995). Counter-storytelling was one component of Critical Race Theory within education that proved to be essential and informative for this research study. Counter-storytelling allows people who are often negatively depicted by racial stereotypes the opportunity to have their voices heard (DeCuir & Dixon, 2004; Delgado & Stefancic, 2001).

One way counter-storytelling can be achieved is through interviews, in particular, the semi-structured interviews used in this study. For this research, I used direct quotes from the participants to get a better understanding of their experiences in mathematics. The quotes came from the responses given to the questions asked during the semi-structured interviews. Each interview was transcribed by hand, and in-vivo coding allowed themes to emerge that represented the true views of the participants (Miles, Huberman, & Saldaña, 2014). In some previous research, direct quotes were not used, and hence more of the views of the researcher came through the findings in their work. Often when studies were conducted regarding African-American students and mathematics, the viewpoint of the instructor was used, neglecting the perspective of the students (Morris, 2007). In McClendon and Wigfield's study of the self-efficacy in mathematics of African-American males and females, one of the few studies that used the perspectives of both male and female students, they gathered their findings from questionnaires and did not use quotes from their participants. (McClendon & Wigfield, 1998). In another study, Jones and Ford also used questionnaires to examine the impact of positive self-efficacy on the performance of male and female African-American students in mathematics (Jones & Ford, 2014). Even though their findings from the questionnaires were important, they removed the ability for the students to clarify with more details the reasoning behind their responses to the questionnaire, which can be done with interviews.

The overarching focus of Critical Race Theory is that racism has caused African-Americans to generally not do well academically and financially (Delgado & Stefancic, 2001). However, the participants in this study proved that even though racism is still prevalent in society, African-American students are able to overcome the negative impacts of it and still achieve. By no means is this to say that the ideas of Critical Race Theory are not valid, because they are, but it points to the ability of African-American students to adjust, adapt, and overcome the obstacles caused by racism in order to be successful.

For this research, I decided it was necessary to interview both male and female participants. Of the research that has been published about African-Americans and mathematics, the focus was usually on why African-American males tend to not perform as well as other demographics in mathematics courses (DeCuir & Dixson, 2004; Thompson & Lewis, 2005). It is rare that the views of both male and female African-American students are used within the same study, since African-American females are often excluded from the studies (Morris, 2007). Typically, the experiences of African-American males are greatly different than the experiences of African-American females in mathematics, and therefore both should be examined (Morris, 2007). Often, either just males or just females are interviewed, making it difficult to determine if there is some connection between the experiences of one gender versus the other.

This research is unique because it looks at the positive aspect of African-American students in math being that the students who participated in the interview were all considered successful in math. Generally, research in math education has focused on the negative components of the experiences of African-American students in mathematics (Ladson-Billings & Tate, 1995). I did not examine what was wrong but took a more constructive approach to see

what the students who were already deemed successful had experienced and whether it could be used to benefit other African-American students.

### **Implications of the work**

It is important that all students, regardless of their race, gender, or socio-economic status, have the support and resources they need to reach their full potential in mathematics. The importance of this section is to present the findings of the research to people who have significant influence on the success of African-American students in mathematics, and education in general. To have the greatest impact on African-American students, the information gathered from this research would be most beneficial if shared with teachers, parents, administrators of schools, and African-American students. However, even though the focus of the research was African-American high school students, the knowledge gained from the research and shared here could potentially be tailored and used for other underrepresented minority students.

#### *Teachers*

For math teachers, it is critical for them to understand that they should treat all of their students the same, regardless of their race or background. By human nature, everyone has their own biases that develop from past experiences, but negative biases of African-American students can be detrimental to their success in mathematics. For example, one of the participants mentioned a situation where his teacher simply ignored his questions or called on him with a reluctant attitude. He went on to say that he thought she was a good teacher, in terms of her methodology for teaching, but he felt as though his race hindered her from interacting with him on the same level as she did the other students. As the result of this bias, he did not ask as many questions or participate in class discussions as he would have in a normal setting without a biased teacher. Another participant also had a math teacher who showed bias tendencies towards

African-American students. The teacher would constantly ask only the African-American students if they understood the concepts while making it appear that the Caucasian students did not have difficulties and did not need to be questioned constantly. As the result of the confidence one of the students had in himself, he did not let his teachers' biases deter him, but that appeared to be more challenging for another student who proclaimed less confidence in his abilities. A third student recalled having a math teacher who taught a class made up of entirely African-American students but did not actually teach them math. The teacher assumed they were not interested and proceeded to tell them personal stories unrelated to the topics they should have been covering. His belief that the students would not actually care about learning math caused an adverse reaction to what the participant viewed as her foundational math class and the foundation of her math experience. When the substitute teacher took over the class, she also had a belief that the students did not care to learn and proceeded to yell at them in order to get them to learn and pay attention in class. These three examples provide information that strongly supports that math teachers should constantly, and consistently, check their biases and how they interact with students to ensure that they are not treating their students differently simply because of their race. Teacher self-reflection and evaluation would help reduce the negative experiences that students have with their teachers by way of poor treatment as the result of the race of the student.

It is also of the utmost importance that math teachers support and encourage their students. How the support and encouragement is provided can, and should vary, but when students know that their teachers believe in them and support their efforts, it makes a big difference in how they view their abilities in math. From previous research, it was found that math teachers listening to the ideas of their African-American students increased their positive

self-efficacy (Borman & Overman, 2004; Taba & Elkins, 1966). This was confirmed in the research by two of the participants. One student mentioned that it made him feel good when his teacher asked him to help solve a problem in class because he believed it showed that the teacher valued his contribution to the work and believed he was able to do the work. Another student had a similar experience where his teacher asked him to share his method of solving trigonometry problems by sharing his shortcut with the class. In just these two cases, it was noted that having a teacher value the work of the African-American students had a positive impact on their self-efficacy and made them believe they were able to be successful in the course.

The easiest form of support that math teachers can provide is verbal encouragement, as mentioned by all of the interview participants, but summed up best by this quote, “I definitely feel that my teachers have given me that verbal support... telling me... “you can do this and... I believe in you and I believe in your ability to succeed”... to have that... is really beneficial.” Simply saying “I believe in you” can have a profound impact on how African-American students view their abilities in a math class, which was seen and reiterated in each interview. The findings in the study coincided with previous studies that also mentioned that students who have teachers that reassured them they were able to do well in a math course had positive self-efficacy (Noble, 2011). Teachers have an even more crucial role if the parents of their students are not actively involved in their math education. One of the participants in this study relied heavily on the support and encouragement she received from her teachers. She said that her teachers’ verbal encouragement helped to build her confidence and make her believe she was able to do well in the course, even when she faced challenges understanding concepts.

### *Parents of African-American students*

To many African-American students, their parents play a vital role in their success in mathematics. As stated earlier, previous research has shown that having a supportive family has an impact on the self-efficacy and success of African-American students in mathematics (Terenzini et.al, 1994; Gainor & Lent, 1998; Gutman, 2006). The most important thing for parents to know and understand is that they do not have to know the material to help their student succeed in mathematics. This was confirmed by the fact that all but one of the interview participants mentioned how their parents had not been able to help them with their math homework for a while. Just simply being there for their students and providing encouraging words can go a long way in positively impacting the success of African-American students in math. Providing a listening ear and giving comfort when students are feeling low are other ways that parents can help facilitate success. Parents need to know that it means the world to students to have parents there to listen to how they feel and at the same time give them an emotional boost when they need it. One participant summed this up best when he said, “I think for sure that if every parent, like, gave their kids just a little minimum of support... just a little push in the direction of being greater than they think they are, then they would [be successful].”

### *Administrators*

Administrators also play a pivotal role in the success of African-American students in mathematics. The number one way administrators can improve the success of their African-American students is by hiring teachers who sincerely care about all students, regardless of their race or background. It may be challenging, but hiring teachers that represent the students, if possible, would also improve success and generate positive self-efficacy of African-American students in math. Having an authority figure that looks like them boosts the moral and self-

image of the African-American students. One student said, “It's hard to believe that you can succeed, if you don't see other people who have done it already who look like you succeeding”. Two examples from this study support this recommendation. The same participant had a female African-American teacher who he felt was there to support him and gave him help whenever he needed. He was one of the only black students in the class and having an African-American teacher he could relate to was valuable. Another student also had African-American teachers that she felt she could relate to and was empowered by having someone who looked like her in charge of the course.

Finally, my study indicated that providing teachers with the resources they need to support their students, whether through professional development workshops or through discussion panels, could also be important. Administrators need to make sure teachers are able to positively interact with diverse students and control their biases in order not to negatively impact the students.

#### *African-American students*

I was asked to consider implications for all African-American students. I note this is quite challenging as my population of students all came from a magnet school and so they are not “typical”. However, there does appear to be a common factor that can be mentioned. The participants all expressed a high degree of self-motivation and desire for success. I suggest that even when African-American students do not have support from their parents, teacher, or peers, they might do well if they have self-motivation and determination. That means, regardless of what they face, or what is going on around them, if they want to do well in math, they must do what they think is necessary to succeed. This could include receiving help from their teacher outside of class, or another individual who understands the challenging concepts. African-

American students should also work with their peers when they can, possibly forming study groups, to help facilitate understanding of concepts as well as complete practice problems. With so many other resources and the technology available today, utilizing additional resources outside of the classroom, such as videos or additional practice problems found online, would also prove to be beneficial.

Additionally, I would suggest that African-American students have a goal in order to help them become successful in mathematics. In having a goal, they can plan the necessary steps they need to take in order to reach their goal. The big question would be what drives African-American students to do whatever is necessary, no matter how hard it gets? Being able to determine the resources available and how they would best be used to reach their goal is important. Trey said, "... I have a pretty clear vision of where I want to go and I know what it takes to get there. So, I know I'm going to have to work hard". African-American students cannot be afraid or discouraged by having to work hard. It is necessary to be successful in mathematics. Tam said, "... if anyone thinks I can't do something, I prove them wrong and then some... I will never, ever let anyone hold me back from my potential. My education is always number one. And if you think I can't do it... I'm going to prove you wrong..." which shows the importance of ignoring outside forces that do not support your vision of success.

### **Future Research**

There are still some unanswered questions in terms of why the students in this study were successful in mathematics when compared to national standardized test scores which indicate that as African-Americans, they would not be (Nation's Report Card, 2019). In this section, I discuss some of the specific ideas I have for my future research.

There are possibly other environmental factors that impact the success of African-American students which did not show up in this study, and those factors need to be explored. For a new study, I would continue with semi-structured interviews, but I would develop a protocol with questions created specifically to draw out more details regarding the living environment and school setting of the participants. The questions I would ask would determine who else lived with the participants, such as grandparents, cousins, aunts, and/or uncles. Knowledge of the other members in the household is important because it sheds light on the possible environment the students have to study in. With more people within a house, it could potentially impact the noise-level and the time that students are able to study without interruption. Another question I would ask would be if the participant has to share a room with another family member. Again, this could impact their ability to have a quiet place to study and learn. Most of the participants come from a two-parent household, so incorporating students that come from a single-parent household would add another perspective. Even though the education level of the parents were included, I did not ask about their field of study or the type of work the parents did. It is my hypothesis that having a parent, or two, who have science related majors or careers could potentially impact the support the parent(s) are able to provide their child, using their knowledge of mathematics. This factor may then influence the self-efficacy and success of the students knowing they have a parent that is able to help them understand challenging concepts in mathematics.

Having a study that looks closely at the confounding variables from this research study would also include going into more details about the school environment of the participants. A third factor that would be studied is the race of the other students in classes and how often participants are one of a few black students in their class; not a lot is known about the

demographics of their peers, and the potential impact it can have. I believe that changing the classroom environment in order to benefit African-American students would not be ethical, but changing the environment would shine more light on how the environment could affect African-American students' self-efficacy and success, or motivation, a possible factor that was not included in this study, but will be discussed a little later. Making sure the study still uses semi-structured interviews is vital in ensuring that the views of the participants are provided in an unbiased manner.

Another question that still needs to be answered is what happens in the cases where the parents and teachers are supportive of African-American students, but they are still not deemed successful in mathematics? What are the underlying factors in those instances? This research study was unique in that all of the participants were already classified as being successful in mathematics because of the math course they were taking and their grade in the math course. It was a common theme that all of the participants had parents and teachers that supported them in some way. It is likely that there are students who are not considered successful in mathematics, but they also have supportive parents and teachers.

The purpose of the new study would be to understand why the students are unsuccessful in math when they have the type of supportive parents and teachers that the students in this study had. Again, semi-structured interviews would be conducted to obtain the words and experiences of these students. The process used to identify such students would be challenging as asking a group of students what math they are taking and their current grade in the course may be inappropriate. One approach for this study might be to go to a high school and first identify teachers that are supportive in similar ways that were found in this study. I would determine how they support their students by having them fill out a questionnaire and compare their

responses to the known ways teachers were found to be supportive in this research study. After I have identified the teachers with similar support mechanisms, I would then ask them to help me identify their students who are not taking advanced mathematics courses and who do not have an A or B in their math course. With the potential students that are identified, they would then complete a questionnaire to obtain more information about the support received from their parents. I would select the students who acknowledged similar support from their parents to participate in the new study. Having new participants who had supportive parents and teachers comparable to the students in my research study would hopefully allow me to investigate underlying factors that potentially prevent them from being successful in mathematics. With the new study, I would again look at the home life, environment where they live, and also their interactions with their peers. This would be a good time to also examine their self-efficacy. In this study, I would want to further examine their motivation, or lack thereof, in mathematics. As mentioned previously, motivation will be discussed in a later section.

For a next step, I would like to examine teacher practices currently in place and how those practices may impact the success of African-American students in high school mathematics. Are the practices that teachers are introduced to in pre-service education and through professional development conducive to the learning and understanding of African-American students, or are there changes that should take place to better support their needs? This study did not examine the best practices used by instructors, but practice was seen as a minor factor identified by some of the participants.

Being that all of the interview participants came from a similar living situation, future research would look into successful African-American students who come from a single-parent household, or whose parents do not own their own home. It is important that the broader

community understands that just because an African-American student comes from a single-parent household does not mean that they are unable to be successful in mathematics. More research is needed in this area so that more African-American students will be represented and better supported by the findings. Making housing more affordable and accessible to African-American families would also be important if it is determined that having a home is a true factor in success, but again that is not conclusive from this study since the socioeconomic representation was limited.

A final question for future research would be what role does the motivation of the students play? In considering motivation, I would like to examine what happens when students do not have supportive parents or teachers, or any other outside influences. Motivation would be defined as the internal factors that cause the students to pursue and achieve their goals in mathematics. Just like with the other potential research studies, semi-structured interviews would be used. This study would be different in that I would speak with successful and unsuccessful students to gain a better understanding of what does and does not motivate them. I would gain access to the unsuccessful students in a similar way as described above, and success would still be determined by grades and current enrollment. Being that I believe motivation has a more psychological component to it, I would first have to study more about the psychology of high school students, in particular, African-American high school students and what drives their behavior. With more understanding of their actions, I will be able to craft questions that bring about their true intentions and the motive behind their actions. I was not able to address these questions in this study, but I would address them in future research by adding them to the survey and creating additional interview questions that dive deeper into what motivates, or does not motivate, students to be successful in mathematics.

This current study began as a mixed method study, but due to time constraints and other unforeseen circumstances, the final research study was qualitative in nature. That being said, I would propose a new study that examines quantitative aspects. The first obstacle to overcome would be having enough students to conduct a quantitative study. There was only a total of fifty-six African-American students and not all of them responded to the request to participate in the research. Finding fifty successful and fifty unsuccessful students who are willing to complete the survey and potentially participate in the interview portion of the study would be ideal. In order to begin obtaining the number of students needed, I would have to increase the number of schools that I am able to work with. I would then have to decide if I want the students to come from various areas in the region, or if I want to stick to a particular county to help reduce the confounding variables. This new study would build on the results from the current work but focus on developing a hypothesis-driven quantitative portion to integrate with the new qualitative data. Statistical analysis would contribute and add to the results of this study and be important to future work in this area.

## **Conclusion**

The purpose behind the research was to help understand and dismantle the discrepancy that occurs between the achievement of African-American and Caucasian students in mathematics, according to standardized test scores (The Nation's Report Card, 2019). Initially, I had the idea that standardized tests were the only way to demonstrate success of students in mathematics, but with additional research, it was found that there were numerous ways to establish success in mathematics (Gainor & Lent, 1998; Gutman, 2006). Being that African-American students tend to not perform well on standardized tests in comparison to Caucasian students (Berry, 2008), it was determined that for this research, placement in math courses and

grades within the course would determine success, as these were two elements that were noted to identify success (Berry, 2008; Berry, et al., 2014; Ellington & Frederick, 2010; Moody, 2004; Noble 2011; Walker, 2006; Tucker, 2000). In order to begin to reduce the gap that occurs between the test scores of African-American and Caucasian students, it is first necessary to understand what potentially the driving forces were behind African-American students that were considered successful in mathematics. To do this, I examined both environmental factors, specifically parents and family, teachers, and peers, as well as the personal factor of self-efficacy.

To conduct the study, I looked for input from students who are successful in mathematics. It was important that I found that even though the students in the study represented roughly half of the total population at the specialized high school, there was little to no variation in the socio-economic status established by the proxies. This trend of similarity continued in the rest of the results.

From the findings, socio-economic status, living environment, and parent education had little significance on the African-American students being successful in mathematics. For example, the education level obtained by the parents had no bearing on whether or not their child would be successful in mathematics. Alternatively, the factors that did appear to have the most impact on the achievement of the students was the support and encouragement they received from their parents and teachers. The support from the parents came mostly as verbal encouragement, but also mental support by simply listening to the students when they needed someone to talk to about the challenges they faced in their math courses. Parents being able to help students with their math homework did not matter.

Teachers were influential in the success of African-American students in a similar fashion. Successful students in mathematics noted that they had teachers who provided verbal encouragement, support through extra help or practice problems, and viewed them as a person and not a grade on a test.

Peers were the last factor that was examined to determine the impact on the success of African-American students. It was noted that many of the students had both supportive peers and peers that did not believe they could be successful in mathematics because of their race. Like with the parents and teachers, peers often provided verbal encouragement, and at times competition was a driving force for the participants to do their best in a course. As with teachers, not all peers were supportive, but overall, the participants did not let negative interactions with their peers keep them from performing well in mathematics. Examining the cases where teachers and peers presented negative interactions brought up the idea that an internal factor could also influence success, hence self-efficacy was also examined.

Self-efficacy for this research study was defined as how the participants viewed their abilities within mathematics, in terms of their grades, but also solving and understanding problems. As with many of the other factors, it was challenging to establish a direct relationship between self-efficacy and success. All of the participants in the interview were considered successful, yet all of them did not have positive self-efficacy. There were two participants, one male and one female, who had negative self-efficacy when it came to how they viewed themselves in mathematics, yet, by definition, they were still considered successful in mathematics. When examining the questionnaire closer, it appeared to be a connection between self-efficacy and the views of their peers. If a student viewed that their peers were better in

mathematics than they were, they tended to have negative self-efficacy, versus a student who felt they were just as good as their peers in mathematics.

In conclusion, this research study was significant because it gave a firsthand account of what, and who, African-American students felt helped them to become successful in mathematics from the perspective of African-American males and females. Using this information will be beneficial to African-American students in the future as it provides insight to their parents, family members, teachers, peers, and administrators as to what they (the adults) can do to promote the success of the students in mathematics. New research can take the findings developed in this study and see if the same support mechanisms are seen at other schools with African-American students who are classified as successful in math. In time, the achievement gap that currently exists between African-American students and students of other races will diminish, opening the door to advancement in other areas.

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## APPENDICES

## Appendix A - View of Mathematics Survey

**Please answer “yes” or “no” to Questions 1 - 7**

Participation Qualification Questions

1. I classify myself as African-American / black.
2. I completed Math I / Algebra I, or beyond, by the 8th grade.
3. I have an A or B in my current mathematics course.
4. My parent(s) own a house.
5. I live in a rural environment.
6. I live in an urban environment.
7. I live in a suburban environment.

**Please circle the statement that applies for Questions 8 and 9**

8. Mom’s highest education level (high school diploma or GED / 2 year or 4 year / master’s degree or beyond)
9. Dad’s highest education level (high school diploma or GED / 2 year or 4 year / master’s degree or beyond)

**Please answer the following questions on a scale from 1 to 5**

Self-efficacy

10. I believe I am successful in mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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11. I can get good grades in a math course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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12. I am confident in myself when I give my answer to a math problem.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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13. I believe I am able to learn and understand any form of mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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14. I am just as good as my peers in mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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15. My perception of my success in mathematics has changed over the years for the better

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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16. I need to have a strong foundation in mathematics for my future career goals.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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17. I usually feel confident when trying to solve a math problem and know I will eventually get the correct answer.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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18. How I feel about my ability to do well in a mathematics course impacts my success in the course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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19. If I believe I will do well in a mathematics course, I tend to do well in the course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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20. For quality control, please select 4 (Agree)

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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*Self-efficacy (impact of environmental factors)*

21. My interactions with my peers make me believe I am able to do well in mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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22. My interactions with my past math teacher helped me believe I am able to do well in a mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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23. My interactions with my present math teacher helps me believe I am able to do well in a mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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24. My parent(s) help(s) me believe I am able to do well in a mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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25. My family helps me believe I am able to do well in a mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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26. My socio-economic status impacts how I feel about my ability to perform well in a mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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27. My living environment impacts how I feel about my ability to perform well in a mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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Living Environment

28. I believe my living environment has a positive impact on my success in mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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Parental/family Impact

29. My parent(s) help(s) me be successful in mathematics (i.e. helping with homework, giving encouragement, etc.).

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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30. Other family member(s) help(s) me be successful in mathematics (i.e. helping with homework, giving encouragement, etc.).

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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31. I believe my parents' education level impacts my success in mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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32. My success in mathematics is the result of my parents' relationship status.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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33. My parent(s) encourage me to do my best in mathematics courses.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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34. My family encourages me to do my best in mathematics courses.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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35. My parent(s) support(s) my goals in mathematics (i.e. to take higher level courses, to maintain good grades, etc.)

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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36. For quality control, please select 2 (Disagree)

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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37. My family supports my goals in mathematics (i.e. to take higher level courses, to maintain good grades, etc.)

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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Instructor interaction

38. A past instructor helped me be successful in mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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39. My present math instructor has helped me be successful in mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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40. A past math instructor helped me feel as though I could do well in math.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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41. My present math instructor helped me feel as though I could do well in math.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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42. A past math teacher encouraged me to take an advanced mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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43. A past math teacher encouraged me to take an advanced mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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44. My past math teacher motivated me to do well in a mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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45. My present math teacher motivated me to do well in a mathematics course.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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46. I have felt as if a past math teacher did not believe I could do well in math because of my race.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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47. I have felt as if my present math teacher did not believe I could do well in math because of my race.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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*Peer interactions*

48. I have felt as if my peers did not believe I could do well in math because of my race.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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49. My peers applaud my success in mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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50. My peers encourage me to do well in mathematics.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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51. Females are just as good in mathematics as males.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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52. I believe African-American students can do well in a mathematics class.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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53. African-American students are given as many opportunities to be successful in mathematics as people of other races.

<b>1</b> Strongly disagree	<b>2</b> Disagree	<b>3</b> Neither agree nor disagree	<b>4</b> Agree	<b>5</b> Strongly agree
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## Appendix B - Interview Protocol

- Good morning/afternoon/evening!! Thank you for agreeing to participate in this interview and I really appreciate you taking the time to talk with me today. As you know, I am interested in environmental and personal factors that impact the success of African-American high school students in mathematics. For the purpose of this study, a student is deemed successful in mathematics if they are enrolled in a mathematics course that is at a higher level than what is the norm for their grade. That would include students who took Math I/Algebra I in 8th grade, or before, and those who will be enrolled in Calculus and beyond while in high school.
- During this interview, I will ask you a few questions about your views regarding mathematics, as well as how your instructors, parents or guardians, and your peers affect your perception. Keep in mind that what you say here will remain confidential and that your name will never be published or connected with this research in any way.
- Throughout the interview I may ask you to elaborate on a previous answer you've given. Please feel free to ask any clarifying questions you may have during the interview as well.
- In order to return to our conversation later, I would like to audio and video record our conversation today. I will store the interview in a secure file on my laptop that is password and fingerprint protected. During the interview, if you ever want me to stop the recording, please let me know. Please note that all the questions are voluntary, and you may abstain from answering any question if you wish.

### *Self – efficacy*

- 1) Self-efficacy in this study means how you view your ability to do well in a mathematics course. Who, or what, do you believe has/have an impact on your self-efficacy?
- 2) According to your response on the survey, you stated that *peers* impacted your self-efficacy in mathematics. Could you elaborate on this please?
- 3) According to your response on the survey, you stated that *teachers* impacted your self-efficacy in mathematics. Could you elaborate on this please?
- 4) According to your response on the survey, you stated that *parents* impacted your self-efficacy in mathematics. Could you elaborate on this please?
- 5) According to your response on the survey, you stated that *other family members* impacted your self-efficacy in mathematics. Could you elaborate on this please?
- 6) How do you feel about your ability to do well in a mathematics course?

- 7) Provide a time when you felt you did a really good job in mathematics.
- 8) How have your feelings about your ability to do well in mathematics changed over the years?
- 9) Do you believe outside influences have a significant or minimal impact on your perceptions on how you feel about your abilities in mathematics?
- 10) Do you expect to use mathematics in your future? Please explain when and how.

### ***Family***

- 11) How do you feel about your family's involvement in your academic pursuits?
- 12) Do you believe your parent(s) impacts your self-efficacy in mathematics?
  - a) In what ways have they influenced your self-efficacy in mathematics?
- 13) Do you believe your other family members impact your self-efficacy in mathematics?
  - a) In what ways have they influenced your self-efficacy in mathematics?
- 14) If you have brother(s) and/or sister(s), would you consider them to be good in mathematics? Why or why not?

### ***Teachers***

- 15) What did you like about your interactions with your previous math teachers?
- 16) What did you not like about your interactions with your previous math teachers?
- 17) Has a mathematics teacher ever negatively affected the way you felt about your ability to do well in a mathematics course? Explain.
- 18) Has a mathematics teacher ever positively affected the way you felt about your ability to do well in a mathematics course? Explain.
- 19) Without providing their name, talk about a specific teacher that made you feel good about your mathematics performance.
- 20) Without providing their name, talk about a specific teacher that made you feel bad about your mathematics performance.
- 21) Has a mathematics teacher motivated you to be successful in a mathematics course?

- a) In what ways did they motivate you?

***Peers***

- 22) In what ways do your peers encourage or applaud your success in mathematics?
- 23) Have you ever let the opinions of your peers change how you viewed your abilities in a mathematics course?
- 24) Have you ever let the opinions of your peers change how you have participated in a mathematics course?
- 25) Have you ever let the opinions of your peers change the extent to which you have achieved/effort put towards achieving in a mathematics course?
- 26) In what ways do you believe the views of your peers impact your success in a mathematics course, if at all?

***Overall***

- 27.) Between your *parents, family, teachers, and peers*, which would you say has the most impact on ***your self-efficacy?***
- 28.) Between your *parents, family, teachers, and peers*, which would you say has the most impact on your ***success in mathematics?***

## Appendix C- Parental Permission Form

### Parent/Guardian Permission Form

**Title of Study:** Personal and Environmental Factors That Influence the Success of African-American High School Students in Mathematics (**eIRB #20554**)

**Principal Investigator:** Amber E. Smith, [aesmit12@ncsu.edu](mailto:aesmit12@ncsu.edu), 919-416-2634

**Funding Source:** None

**Faculty Point of Contact:** Dr. Karen Keene, [kakeene@ncsu.edu](mailto:kakeene@ncsu.edu), 919-513-3374

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

Your child is invited to take part in a research study. Your child's participation in this study is voluntary. Your child has the right to be a part of this study, to choose not to participate, and to stop participating at any time without penalty. The purpose of this research study is to gain a better understanding of the views and experiences of African-American high school students in mathematics. We will do this through asking your child to participate in an online survey. After completing the online survey, it is possible that your child will be asked to participate in a virtual interview.

Your child is not guaranteed any personal benefits from being in this study. Research studies also may pose risks to those who participate. You may want your child to participate in this research because they will gain a better understanding of what helps them be successful in mathematics. You may not want your child to participate in this research because they may recall negative experiences in mathematics.

Specific details about the research in which your child is invited to participate are contained below. If you do not understand something in this form, please ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If, at any time, you have questions about your child's participation in this research, do not hesitate to contact the researcher(s) named above or the NC State IRB office. The IRB office's contact information is listed in the *What if you have questions about your rights as a research participant?* section of this form.

#### **What is the purpose of this study?**

The purpose of the study is to gain a better understanding of the views and experiences of African-American high school students in mathematics.

#### **Is my child I eligible to be a participant in this study?**

There will be approximately 30 to 50 participants in this study.

In order to be a participant in this study, your child must have your permission to participate, your child must agree to be in the study, and your child must complete the online survey to potentially participate in the interview portion of the study.

Your child cannot participate in this study if they do not want to be in the study, you do not give them permission to be in the study, or they do not complete the online survey.

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

If you agree to allow your child to participate in this study, they will be asked to do all of the following:

1. Take an online survey about their views in mathematics. We expect that the survey should take your child 25 to 40 minutes to complete.
2. If selected, your child will participate in a 60-minute to 90-minute interview to discuss their experiences in mathematics. The interview will be audio recorded, or video recorded, depending on the preference of you and your child.

The total amount of time that your child will be participating in this study is between 60 and 90 minutes, depending on the responses of your child.

### **Recording and images**

As a part of this research, I would like your consent to audio record and/or video record your child. Please initial next to the sentence(s) that you agree to.

\_\_\_\_\_ I give permission for my child to be audio recorded.

\_\_\_\_\_ I give permission for my child to be video recorded.

\_\_\_\_\_ I *do not* give permission for my child to be audio recorded.

\_\_\_\_\_ I *do not* give permission for my child to be video recorded.

### **Risks and benefits**

There are minimal risks associated with participation in this research. The risks to your child as a result of this research include possibly recalling negative experiences in mathematics.

There are no direct benefits to your child's participation in the research. The indirect benefits are gained knowledge of what helps them be successful in mathematics. Also, it is possible to increase, or gain, a positive identity in their abilities in mathematics.

### **Right to withdraw your participation**

Your child can stop participating in this study at any time for any reason. In order to stop your child's participation, please contact Amber E. Smith, by email at [aesmit12@ncsu.edu](mailto:aesmit12@ncsu.edu), or by phone at 919-416-2634. You may also contact the faculty advisor, Dr. Karen Keene, by email at [kakeene@ncsu.edu](mailto:kakeene@ncsu.edu), or by phone at 919-513-3374. If you or your child choose to withdraw consent and to stop participating in this research, you can expect that the researcher will redact your child's de-identified information from their data set, securely destroy your child's data, and prevent future uses of your child's de-identified information for research purposes wherever possible. This is possible in some, but not all, cases.

### **Confidentiality, personal privacy, and data management**

Trust is the foundation of the participant/researcher relationship. Much of that principle of trust is tied to keeping your child's information private and in the manner that we have described to you in this form. The information that your child shares with me will be held in confidence to the fullest extent allowed by law. Protecting your child's privacy as related to this research is of utmost importance to me. However, there are very rare circumstances related to confidentiality where I may have to share information about you or your child. These are limited to instances in which imminent harm could come to your child or others. If your child reports negative or illegal behavior from their previous instructor(s), by law, I will have to report them to the appropriate authorities, but I would only identify your child if necessary. I would let law enforcement determine what I have to share and also insure your child that their identity will be protected to the extent that the law allows.

How we manage, protect, and share your child's data are the principal ways that I protect your child's personal privacy. Data generated about your child in this study will be de-identified. Data that will be shared with others about your child will be de-identified.

**Anonymous.** Anonymous data means that at no time can I nor anyone else link your child's real identity to the information collected during this research. This means that I cannot identify your child at all, even when the data is combined with other information. I will also not seek to identify your child using any techniques or technology.

**De-identified.** De-identified data is information that at one time could directly identify your child, but that I have recorded the data so that your child's identity is separated from the data. I will have a master list with your child's code and real name that I can use to link to your child's information to the research data. While I might be able to link your child's identity to your child's data at earlier stages in the research, when the research concludes, there will be no way your child's real identity will be linked to the data I publish.

**Re-identifiable.** Re-identifiable data is information that I can identify your child indirectly because of access to information, role, skills, and/or use of technology. This may also mean that in published reports others could identify your child from what is reported, for example, if a story your child tells us is very specific. If your child's data is re-identifiable, I will report it in such a way that your child is not directly identified in reports. Based on how we need to share the data, I cannot remove details from the report that would protect your child's identity from ever being figured out. This means that others may be able to re-identify your child from the information reported from this research.

**Identifiable.** Identifiable data is information about your child that directly link your child to this research. This includes, but is not limited to, your child's name, e-mail, phone number, or other details that makes your child easily recognizable to me and others. Identifiable data has your child's real identity directly on the information that are shared with me and other people.

**Compensation**

For your child’s participation in this study, they will receive a gift card valued at \$10. If your child is selected to participate in the interview portion of the study, they will automatically receive a \$30 gift card.

If your child withdraws from the study prior to its completion, they will still receive the gift cards valued at \$10. If your child is selected to participate in the interview and they withdraw before its completion, they will still receive a \$15 gift card.

**What if your child is a student?**

Your child’s participation in this study is not a class requirement and their participation or lack thereof, will not affect their class standing or grades.

**What if you have questions about this study?**

If you have questions at any time about the study itself or the procedures implemented in this study, you may contact the researcher, Amber E. Smith, by email at [aesmit12@ncsu.edu](mailto:aesmit12@ncsu.edu), or by phone at 919-416-2634. The faculty advisor, Dr. Karen Keene, can be reached by email at [kakeene@ncsu.edu](mailto:kakeene@ncsu.edu), or by phone at 919-513-3374.

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

If you feel your child has not been treated according to the descriptions in this form, or their rights as a participant in research have been violated during the course of this project, you may contact the NC State IRB (Institutional Review Board) Office. An IRB office helps participants if they have any issues regarding research activities. You can contact the NC State IRB Office via email at [irb-director@ncsu.edu](mailto:irb-director@ncsu.edu) or via phone at (919) 515-8754.

**Consent to Participate**

By signing this electronic consent form, I am affirming that I have read and understand the above information. All of the questions that I had about this research have been answered. I have chosen to participate in this study with the understanding that I may stop participating at any time without penalty or loss of benefits to which I am otherwise entitled. I am aware that I may revoke my consent at any time.

Child’s printed name \_\_\_\_\_

Parent’s printed name \_\_\_\_\_

I consent for my child to participate in research

I *do not* consent for my child to participate in research

## Appendix D - Student Participation Consent Form (Minors)

### Assent Form for 14 to 17 years old

**Title of Study:** Personal and Environmental Factors That Influence the Success of African-American High School Students in Mathematics (eIRB #20554)

**Principal Investigator:** Amber E. Smith, [aesmit12@ncsu.edu](mailto:aesmit12@ncsu.edu), 919-416-2634

**Funding Source:** None

**Faculty Point of Contact:** Dr. Karen Keene, [kakeene@ncsu.edu](mailto:kakeene@ncsu.edu), 919-513-3374

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I am inviting you to participate in a research study about your experiences in mathematics, inside and outside of the classroom.

Your parent(s)/guardian(s) know we are talking with you about the study. This form will tell you about the study to help you decide whether or not you want to participate in this research.

#### **What is the purpose of this research study?**

The purpose of this study is to gain a better understanding of the views and experiences of African-American high school students in mathematics.

#### **What will I do in this study?**

If you decide to be in the study, I will ask you to complete a survey online that will take between 25 and 45 minutes to complete. Once you have completed the survey, you may be selected to participate in a virtual interview that will be audio- or video-recorded, whichever you and your parent(s) prefer. The interview would take between 60 to 90 minutes.

I expect that you will be in this research study for 25 to 45 minutes to complete the survey and 60 to 90 minutes to complete the interview, if selected.

#### **Can I participate in this study?**

You are invited to participate in this study if you agree to be in this study, your parent or guardian allows you to participate in this study, and if you complete the online survey.

You cannot participate in this study if you do not want to participate in this study, your parent or guardian does not want you in this study, or you do not complete the online survey.

#### **What benefits do I get for participating in this study?**

Taking part in this study does not have any direct benefits for you, but it will help me learn about the experiences and views of African-American students regarding mathematics.

#### **Can anything bad happen if I am in this study?**

There are minimal foreseeable risks; some teens, however, may recall negative experiences in mathematics as it relates to their instructor, peers, or family members, which may cause anxiety. If you have anxiety from recalling your experiences or become tired during the interview, please let me know, and we can take a short break.

**Will anyone know what I said or did in this study?**

If you decide to be in the study, I will not tell anyone else how you respond or act as part of the study. This means that no one outside of the researchers will know that it is you. Even if your parents or teachers ask, I will not tell them about what you say or do in the study. Everything will remain private. In the rare and unusual circumstance that I think you are being hurt by someone else or in danger, I am required by law to tell someone only enough information in order to help you be safe. If you report negative or illegal behavior from their previous instructor(s), by law, I will have to report them to the appropriate authorities, but I would only identify you if necessary. I would let law enforcement determine what I have to share and also insure you that their identity will be protected to the extent that the law allows.

**Do I have to be in the study?**

No, you do not. The choice is yours. No one will get angry or upset if you do not want to do this. You will not lose out on anything if you do not want to do this. You can also change your mind anytime if you decide you do not want to be in the study anymore.

**What if I have questions?**

If you have questions about the study, you can ask me now or anytime during the study. You can also call me at (919) 416-2634 or e-mail me at [aesmit12@ncsu.edu](mailto:aesmit12@ncsu.edu). You may also contact my faculty advisor, Dr. Karen Keen, by email at [kakeene@ncsu.edu](mailto:kakeene@ncsu.edu), or by phone at 919-513-3374.

If you have any questions about your rights as a participant in this research or if you feel you have been hurt by this research, you can contact the IRB Office at [irb-director@ncsu.edu](mailto:irb-director@ncsu.edu) or (919) 515-8754. You will receive a copy of this form for your records.

Printing your name below means that you have read this form or have had it read to you and that you want to be in this study.

**Participant's printed name** \_\_\_\_\_

**Participant's signature** \_\_\_\_\_ **Date** \_\_\_\_\_

## Appendix E - Student Participation Consent Form (18+)

### Adult Student Consent Form

**Title of Study:** Personal and Environmental Factors That Influence the Success of African-American High School Students in Mathematics (**eIRB #20554**)

**Principal Investigator:** Amber E. Smith, [aesmit12@ncsu.edu](mailto:aesmit12@ncsu.edu), 919-416-2634

**Funding Source:** None

**Faculty Point of Contact:** Dr. Karen Keene, [kakeene@ncsu.edu](mailto:kakeene@ncsu.edu), 919-513-3374

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

You are invited to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate, and to stop participating at any time without penalty. The purpose of this research study is to gain a better understanding of the views and experiences of African-American high school students in mathematics. We will do this through asking your child to participate in an online survey. After completing the online survey, it is possible that your child will be asked to participate in a virtual interview.

You are not guaranteed any personal benefits from being in this study. Research studies also may pose risks to those who participate. You may want to participate in this research because they will gain a better understanding of what helps them be successful in mathematics. You may not want to participate in this research because you may recall negative experiences in mathematics.

Specific details about the research in which you are invited to participate are contained below. If you do not understand something in this form, please ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If, at any time, you have questions about your participation in this research, do not hesitate to contact the researcher(s) named above or the NC State IRB office. The IRB office's contact information is listed in the *What if you have questions about your rights as a research participant?* section of this form.

#### **What is the purpose of this study?**

The purpose of the study is to gain a better understanding of the views and experiences of African-American high school students in mathematics.

#### **Am I eligible to be a participant in this study?**

There will be approximately 30 to 50 participants in this study.

In order to be a participant in this study, you must agree to be in the study and you must complete the online survey to potentially participate in the interview portion of the study.

You cannot participate in this study if you do not want to be in the study or you do not complete the online survey.

#### **What will happen if you take part in the study?**

If you agree to participate in this study, you will be asked to do all of the following:

Take an online survey about their views in mathematics. We expect that the survey should take you 25 to 40 minutes to complete.

If selected, you will participate in a 60-minute to 90-minute interview to discuss your experiences in mathematics. The interview will be audio recorded, or video recorded, depending on your preference.

The total amount of time that you will be participating in this study is 60 to 90 minutes, depending on your responses.

### **Recording and images**

As a part of this research, I would like your consent to audio record or video record you. Please initial next to the sentence(s) that you agree to.

\_\_\_\_\_ I consent to being audio recorded.

\_\_\_\_\_ I consent to being video recorded.

\_\_\_\_\_ I *do not* consent to being audio recorded.

\_\_\_\_\_ I *do not* consent to being video recorded

### **Risks and benefits**

There are minimal risks associated with participation in this research. The risks to you as a result of this research include possibly recalling negative experiences in mathematics

There are no direct benefits to your participation in the research. The indirect benefits are gained knowledge of what helps you be successful in mathematics. Also, it is possible to increase, or gain, a positive identity in your abilities in mathematics.

### **Right to withdraw your participation**

You can stop participating in this study at any time for any reason. In order to stop your participation, please contact Amber E. Smith, by email at [aesmit12@ncsu.edu](mailto:aesmit12@ncsu.edu), or by phone at 919-416-2634. The faculty advisor, Dr. Karen Keene, can be reached by email at [kakeene@ncsu.edu](mailto:kakeene@ncsu.edu), or by phone at 919-513-3374. If you choose to withdraw your consent and to stop participating in this research, you can expect that the researcher(s) will redact your de-identified information from their data set, securely destroy your data, and prevent future uses of your de-identified information for research purposes wherever possible. This is possible in some, but not all, cases.

### **Confidentiality, personal privacy, and data management**

Trust is the foundation of the participant/researcher relationship. Much of that principle of trust is tied to keeping your information private and in the manner I have described to you in this form. The information that you share with me will be held in confidence to the fullest extent allowed by law.

Protecting your privacy as related to this research is of utmost importance to me. There are very rare circumstances related to confidentiality where I may have to share information about you. Your information collected in this research study could be reviewed by representatives of the University, research sponsors, or government agencies (for example, the FDA) for purposes such as quality control or safety. In other cases, I must report instances in which imminent harm could come to you or others. If you report negative or illegal behavior from their previous instructor(s), by law, I will have to report them to the appropriate authorities, but I would only identify you if necessary. I would let law enforcement determine what I have to share and also insure you that your identity will be protected to the extent that the law allows.

How I manage, protect, and share your data are the principal ways that I protect your personal privacy. Data that will be shared with others about you will be de-identified

**Anonymous.** Anonymous data means that at no time can I or anyone else link your real identity to the information collected during this research. This means that I cannot identify you at all, even when the data is combined with other information. I will also not seek to identify you using any techniques or technology.

**De-identified.** De-identified data is information that at one time could directly identify you, but that I have recorded this data so that your identity is separated from the data I will have a master list with your code and real name that I can use to link to your information to the research data. When the research concludes, there will be no way your real identity will be linked to the data I publish.

**Re-identifiable.** Re-identifiable data is information that I can identify you indirectly because of my access to information, role, skills, combination of information, and/or use of technology. This may also mean that in published reports others could identify you from what is reported, for example, if a story you tell us is very specific. If your data is re-identifiable, I will report it in such a way that you are not directly identified in reports. Based on how we need to share the data, I cannot remove details from the report that would protect your identity from ever being figured out. This means that others may be able to re-identify from the information reported from this research.

**Identifiable.** Identifiable data is information you that directly links you to the data. This includes, but is not limited to, your name, e-mail, phone number, or other details that makes you easily recognizable to me and others. Identifiable data has your real identity directly on the information that is shared with me and other people.

### **Compensation**

For your participation in this study, you will receive a gift card of your choice valued at \$10. If you are selected to participate in the interview portion of the study, you will automatically receive a \$30 gift card.

If you withdraw from the study prior to its completion, you will still receive the gift card valued at \$10. If you are selected to participate in the interview and you withdraw before its completion, you will receive a \$15 gift card.

**What if you are an NCSSM student?**

Your participation in this study is not a course requirement and your participation, or lack thereof, will not affect your class standing or grades at NCSSM.

**What if you have questions about this study?**

If you have questions at any time about the study itself or the procedures implemented in this study, you may contact the researcher, Amber E. Smith, by email at [aesmit12@ncsu.edu](mailto:aesmit12@ncsu.edu), or by phone at 919-416-2634. The faculty advisor, Dr. Karen Keene, can be reached by email at [kakeene@ncsu.edu](mailto:kakeene@ncsu.edu), or by phone at 919-513-3374.

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

If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact the NC State IRB (Institutional Review Board) Office. An IRB office helps participants if they have any issues regarding research activities. You can contact the NC State IRB Office via email at [irb-director@ncsu.edu](mailto:irb-director@ncsu.edu) or via phone at (919) 515-8754.

**Consent to Participate**

By signing this electronic consent form, I am affirming that I have read and understand the above information. All of the questions that I had about this research have been answered. I have chosen to participate in this study with the understanding that I may stop participating at any time without penalty or loss of benefits to which I am otherwise entitled. I am aware that I may revoke my consent at any time.

**Participant's printed name** \_\_\_\_\_

I consent to participate in research

I *do not* consent to participate in research