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# African American Males Pursuing STEM Degrees: A Phenomenological Case Study

Dante Edwards

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## ACCEPTANCE

This dissertation, African American Males Pursuing STEM Degrees: A Phenomenological Case Study, by Dante E. Edwards, was prepared under the direction of the candidate's Study Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this study has met all standards of excellence and scholarship as determined by the faculty.

---

Christine D. Thomas, Ph. D.  
Committee Chair

---

Desha L. Williams, Ph. D.  
Committee Member

---

Tisha Lewis Ellison, Ph. D.  
Committee Co-chair

---

Joseph R. Feinberg, Ph. D.  
Committee Member

---

Date

---

Gertrude M. Tinker Sachs  
Chairperson, Department of Middle and Secondary Education

---

Paul A. Albero, Ph. D.  
Dean  
College of Education

## **AUTHOR'S STATEMENT**

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DANTE E. EDWARDS

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Dante Etienne Edwards  
223 Rosewood Way  
Atlanta, GA 30311

The director of this study is:

Christine D. Thomas  
Department of Middle and Secondary Education  
College of Education  
Georgia State University  
Atlanta, GA 30303

## CURRICULUM VITAE

Dante E. Edwards

ADDRESS: 223 Rosewood Way  
Atlanta, GA 30311

### EDUCATION:

Ph. D.	2015	Georgia State University Middle and Secondary Education
Educational Specialist	2007	Georgia State University Mathematics Education
Masters Degree	2002	Georgia State University Mathematics Education
Bachelors Degree	2001	Morris Brown College Mathematics

### PROFESSIONAL EXPERIENCE:

2010-present	Academy Leader Atlanta Public Schools
2007-2010	Magnet Coordinator Atlanta Public Schools
2002-2007	Teacher Atlanta Public Schools

AFRICAN AMERICAN MALES PURSUING STEM DEGREES: A  
PHENOMENOLOGICAL CASE STUDY

by

DANTE E. EDWARDS

Under the Direction of Christine D. Thomas, Ph. D.

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## ABSTRACT

A disturbing epidemic in the United States is there are too few African American males that graduate from high school and go on to pursue degrees in science, technology, engineering, and mathematics (STEM) (Harper, 2012). An explanation as to why this is so may reside in their experiences while in high school. By using attribution theory as a theoretical framework, this study allowed its participants to identify those events that led them to pursue STEM degrees as undergraduates. Applying a phenomenological case study as a methodology uncovered the essence of the phenomenon of four African American males' lived experiences in secondary mathematics who went on to pursue STEM degrees as undergraduates: self-confidence. Other important factors that were identified but were not the essence include happiness, financial aid, college preparatory activities, the role of influential teachers, science, technology, engineering, and mathematics themed secondary schools and religion.

INDEX WORDS: STEM, African American, males

AFRICAN AMERICAN MALES PURSUING STEM DEGREES: A  
PHENOMENOLOGICAL CASE STUDY

by

DANTE E. EDWARDS

A Dissertation

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## Chapter 1

### INTRODUCTION

A disturbing epidemic in the United States is there are too few African American males that graduate from high school and go on to pursue degrees in science, technology, engineering, and mathematics (STEM) (Harper, 2012). An explanation as to why this is so may reside in their experiences while in high school. By using attribution theory as a theoretical framework, this study allowed its participants to identify those events that led them to pursue STEM degrees as undergraduates. Applying a phenomenological case study as a methodology uncovered the essence of the phenomenon of four African American males' lived experiences in secondary mathematics who went on to pursue STEM degrees as undergraduates. Results of this study are significant for educators, parents, and African American males as to those things that positively influence African American males to pursue STEM degrees. Awareness of these events should increase the number of African American male that major in STEM fields.

#### Problem Statement

People who have a background in science, technology, engineering and mathematics (STEM) related fields have an economic advantage over those who do not. As a group, African American males have yet to tap into this potential source of prosperity. The story that is most commonly told regarding African American males in STEM related fields is lack of representation as undergraduates. A counter-story is a story that is contrary to the most popular view of a particular phenomenon. Counter to the established body of literature, this study shared the lived experiences of four African American males who chose to pursue STEM degrees as undergraduates. The descriptive statistics provided are not meant to add to what Gutierrez (2008) refers to as the "gap-

gazing fetish” (p. 357) between African American males and their counterparts; rather, it highlighted the need for counter-storytelling.

Not since *Brown v. Board of Education* (1954) has a single piece of legislation had a greater effect on the landscape of education than No Child Left Behind (NCLB) (2002). NCLB called for rigorous standards and results from standardized tests to measure school performance. Assistance was provided to schools that failed to succeed (Tate, 2008). Adequate Yearly Progress (AYP) was the accountability tool found within NCLB that forced schools and school districts to look deeper than overall performance on these standardized assessments (Matthews, 2005). Data were disaggregated into subcategories based on race and economic status to ensure all students were achieving. Some of the racial disparities in mathematics proficiency from both national and state levels are listed below.

The United States Department of Education (2009) reported that African-Americans trailed Whites in mathematics proficiency from 1978 to 2008. Additionally, African American students’ proficiency levels decrease dramatically in the ninth through twelfth grades. On average, the percentage of students at or above level in mathematics by the time they were in the twelfth grade was 1.2%. In other words, nearly 99% of students performed below grade level by the time they reach the twelfth grade. National Assessment of Educational Progress revealed that only a quarter of all African American students were at basic level of mathematics ability by their twelfth grade year (United States Department of Education, 2010). These statistics could have played a part in the gap in graduation rates between African Americans and Whites. While the graduation

rate of Whites was 78%, the graduation rate of African Americans was significantly behind at 47%.

Disparities in mathematics between African Americans and other races were evident at the state level as well. Students in the particular state in which this study was conducted were mandated to take a state examination to achieve graduation candidacy including one test in mathematics. Overall, students met or exceeded the standard in mathematics at a 91% rate; however, African American students met or exceeded the standard at a rate of 81% (Georgia Department of Education, 2010). This figure represented a three-point decline from 2009 to 2010.

Additionally, students in the same state took an End-of-Course-Test at the end of their ninth and tenth grade mathematics courses. For the ninth grade class entering fall 2011, these exams accounted for 20% of the student's course grade; however, participants for this study fell into the previous criteria that mandated the exam to count for 15% of the course grade. Overall, 64% of students passed their ninth grade mathematics course and 52% passed their tenth grade mathematics course. African Americans passed at a 49% and 34% rate respectfully.

The same disparity was apparent when ACT and Scholastic Aptitude Test (SAT) scores were reviewed. African American students averaged 16.9 out of 36 on the mathematics portion of the ACT between 1998 and 2008 while their White counterparts outperformed them (American College Testing Program, 2009). This correlates to SAT data during the same time period where African American students only averaged 425 out of 800 on the mathematics portion of the exam while Whites averaged 533 (College Entrance Examination Board, 2009). These poor statistics had ramifications on college

attendance of African American males. Harper and Griffin (2010) found that only 4.3 percent of all students enrolled in colleges and universities in 2002 were African American males. Most disheartening was that this is the same rate as 1976 (Harper & Griffin, 2010).

### Purpose

The purpose of this study was to unearth those attributes African American males ascribe to them pursuing STEM degrees as undergraduates. The previous statistics of the performance of African Americans and African American males in mathematics brought to light the need to actively seek out those who were able to successfully navigate high school mathematics and go on to major in STEM fields as undergraduates. Although every educational experience from birth helped to define them academically, indicators such as GPA and SAT/ACT scores earned while in high school are what students needed in order to gain admittance into colleges and universities and ultimately STEM careers.

Through the unique pairing of attribution theory as a theoretical framework and phenomenological case study as a methodology, this study's design revealed the essence of the phenomenon of African American males graduating from high school and continuing on to pursue a STEM degree as undergraduates. The discovery of the essence of the phenomenon of African American males pursuing STEM degrees as undergraduates and revealing who or what they attribute to their ability to navigate high school academia provide parents, educators, as well as African American males themselves with a template in which to use to nurture that essence in an effort to increase the number of African Americans males majoring in STEM.

## Research Questions and Overview of Methodology

The research question guiding this study is: In what ways do undergraduate African American males who are pursuing science, technology, engineering, and mathematics (STEM) degrees describe their experiences in high school? This question sought to examine the lived experience of participants, thus the design of this study was qualitative and used a phenomenological case study as a methodology. Moustakas (1994) stated that phenomenology as a methodology occurs in three phases: preparation, data collection, and organizing and analysis of data. Preparation includes a clear and precise research question where phenomenology is appropriate and an initial literature review is conducted (chapters 1 and 2), data collection is done through long and in-depth semi-structured interviews (chapter 3), and the organization and analysis of data is done through specific coding techniques (chapter 4) (McMillan & Schumacher, 2006; Moustakas, 1994; Schram, 2006). The phenomenon this study examined was the high school experiences of African American males who are currently pursuing STEM degrees as undergraduates.

Yin (1984) stated a case study is the “implicit companion” of qualitative analysis (p. 58). Thus, case study can be used in conjunction with other qualitative strategies of inquiry; including phenomenology. Phenomenology usually employ case study as a methodology that focuses on a small number of participants to promote prolonged and intense engagement between researcher and participants in an effort to develop patterns among the participants (Creswell, 2003; Grbich, 2007; Schram, 2006).

Case study is a common methodology for phenomenological studies due to its ability to examine a phenomenon in a context where the connection between

phenomenon and boundary is not clearly evident (Yin, 1981). The “not clearly evident” is a direct connection to phenomenology that seeks the essence of a phenomenon, which is also not clearly evident. Phenomenology increases the understanding of lived experiences (McMillan & Schumacher, 2006) and case studies provide information for transferability. The methodology of a phenomenological case study is expanded in chapter 3.

#### Theoretical Framework: Attribution Theory

Definition, purpose, and placement of theories in qualitative research have been the subject of much debate (Anfara & Mertz, 2006; Creswell, 2003; Schram, 2006). Kerlinger (1979) defines theory as “a set of interrelated constructs (variables), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables...” (p. 64). Anfara and Mertz (2006) defined theoretical frameworks as “any empirical or quasi-empirical theory of social and/or psychological process...that can be applied to the understanding of phenomena” (p. xxvii).

The purpose or usefulness of theory can either 1) have little impact on the research, 2) is related to the study’s methodology, or 3) have significant impact on the research (Anfara & Mertz, 2006). Qualitative scholars who attest that theory has little impact on research use it in broad terms much like quantitative researchers who often do not include theory into their studies. The third case encompassed the second and extends throughout the entire study. Creswell (2006) said theoretical frameworks “*may* be integrated into philosophical assumptions” (p. 10). Scholars that ascribe to the notion that theory is essential, feel the combination of methodology and theory work in conjunction with one another in an effort to focus the entire study from the onset (Anfara

& Mertz, 2006). Furthermore, these scholars recognize what the “researcher brings to the study...affects all aspects of the study” (p. xxvi). Attribution theory is used in this study as the theoretical framework to examine African American males who graduate from high school and are currently pursuing STEM degrees. Attribution theory provides a framework for participants to accurately identify those experiences that influenced them to pursue a STEM related degree.

Attribution theory has been the dominant concept in motivation, social psychology and educational psychology (Weiner, 2000). Attribution theorists deal with how individual’s perceived ability and difficulty of a task affect the outcome on said task (i.e., learning task) (Seegers, Cornelis, & Vermeer, 2004). Simply, it is the process by which individuals explain their success (Martinko, Harvey, & Dasborough, 2011). Weiner (1974, 1986, 2000, & 2010) has become the leading scholar in attribution theory. He developed attribution theory as a theoretical framework for explaining why people do what they do (Weiner, 1974, 1986). Attribution theory has lasted this long, by being able to morph from its beginnings to meet objections and challenges (Weiner, 2000).

In its infancy stage, attribution theory began as drive theory whose creators were Clark Hull and Kenneth Spence (Weiner, 2010). At that time, motivation was thought to depend on human need multiplied by applicable behaviors that were strengthened by rewards (Weiner, 2010). During the same period, Edward Tolman, Julian Rotter and John Atkinson developed a competing theory: expectancy/value theory (Weiner, 2010). In contrast to drive theory, expectancy/value theory suggested a person begins with expectancy of success rather than a need. The level of expectancy is intensified by the

likelihood of actually attaining what is expected. Value is attributed based on the emotion evoked from success or failure (Weiner, 2000).

Weiner's work was based on Atkinson's view of expectancy/value theory, which diverted from Tolman and Rotter (Weiner, 2010). Atkinson (1957) inserted three additional principals: 1) motivation begins with individual motives, 2) value has a broader sense than simply pleasure and pain, and 3) value is inversely related to expectancy of success. This and all previous iterations did not satisfy Weiner conception of what attribution theory could and should be due to its lack of predictability.

Weiner took what he knew from previous works of his own and those of others and analyzed two theories of motivation: interpersonal and intrapersonal theory. Such self-directed thoughts like self-esteem, guilt and shame were intrapersonal whereas being judged by others was interpersonal. Locus, stability, and controllability are components of interpersonal theory (Weiner, 1985, 2000, 2010). Locus is either internal or external, stability is the expected length of time the cause will act upon the subject, and controllability is the degree the subject has to affect the outcome (Weiner, 2000). Behavioral outcomes are dependent on independent emotions and expectancy of success (Weiner, 2000).

Conversely to the subject attributing causality in intrapersonal theory, external persons such as parents, peers, and teachers assign causes in interpersonal theory (Weiner, 2000). These causes do not necessarily correlate to those of the subject. External observers tend to have feelings of sympathy when a person fails, but has low ability; however, feelings of anger arise when a capable person fails due to perceived lack of effort. This is because of the level of "free will" a participant has on the outcome

(Weiner, 2000, p. 9). It is reasoned that internal factors attributed to success is greater than external (Weiner, 2010). The final attribution-based theory of intrapersonal motivation is shown in Figure 1.

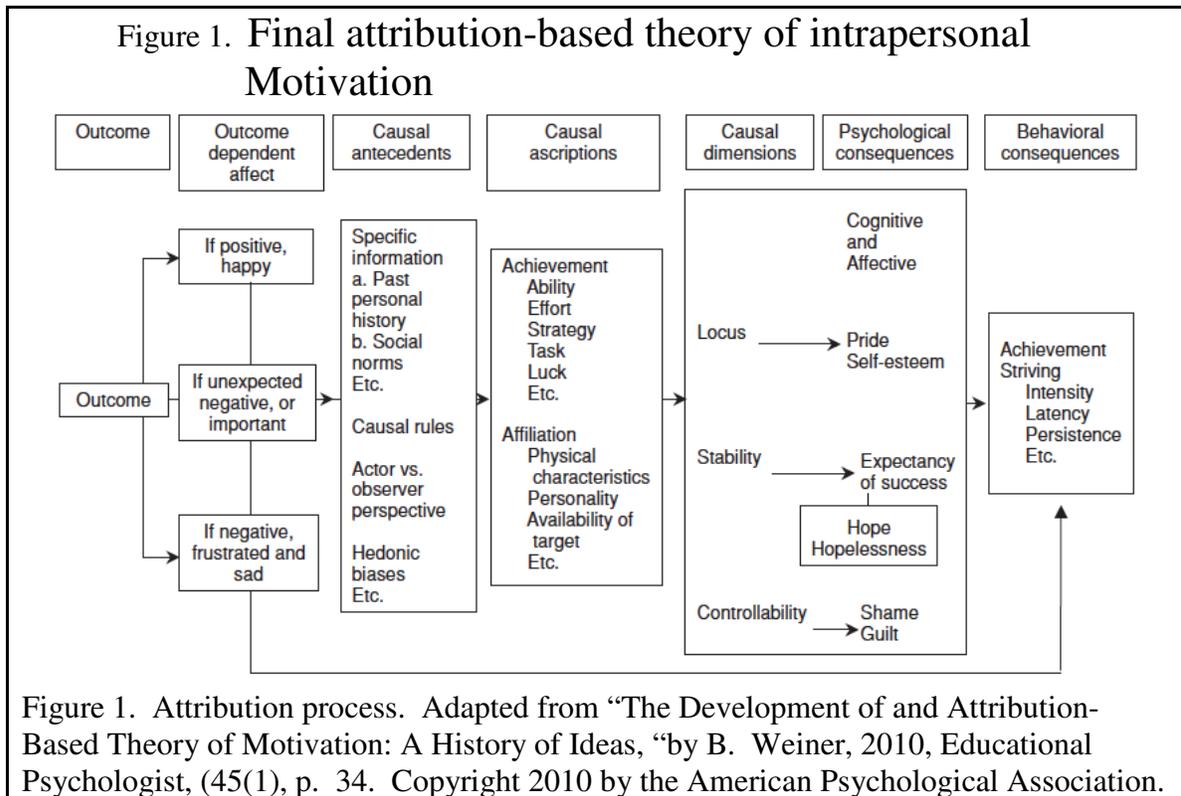


Figure 1 shows the process an individual goes through when they experience an outcome from an event. They first experience a sense of happiness or sadness followed by a reflection of what immediately preceded the event. The reflection reveals if the previous event is due to achievement or affiliation. That ascription funnels into a three-dimensional space that is defined by locus, stability, and controllability whose psychological consequences include anger, gratitude, guilt, hopelessness, pity, pride and shame (Weiner, 1985). Only then are the final behaviors such as achievement striving are presented. This was important to this study because of the pursuit to find the essence

of the phenomenon that influenced these for African American males to “strive” to obtain a STEM degree.

#### Attribution Theory versus Self-Efficacy

Psychologist Bandura conducted numerous studies on self-efficacy and defined it as one’s capabilities to organize and execute courses of action to attain designated goals (Bandura, 1982, 1997). Self-efficacy has the ability to influence thought patterns, actions, and emotional arousal. Causal tests indicate higher self-efficacy correlated to higher performance accomplishments (Bandura, 1982). Zimmerman (2000) compared self-efficacy to other closely related constructs such as outcome expectations, self-concept, and perceived control. Although he does explicitly compare self-efficacy to attribution theory, attribution theory is comprised of two of the compared constructs: outcome expectations and perceived control. Self-efficacy is similar to attribution theory as it is used to measure outcome expectations and is multidimensional; however, it is conceptually different (Zimmerman, 2000).

Self-efficacy was not applicable to this study due to its sensitivity to context, dependence on mastery criterion of said context, and reference to future functioning to perform associated activities (Zimmerman, 2000). The context in which this study resides was undergraduates who were pursuing STEM degrees; however, there was no known criterion in which to master in order to do so. The use of self-efficacy would suggest the source of African-American males pursuing STEM degrees lie somewhere in the realm of science, technology, engineering or mathematics. Attribution theory allowed participants the ability to ascribe to a broad range of possibilities. Furthermore, it does not pair as well with the chosen methodology of phenomenological case study which

sought to arrive at the essence of a phenomenon. Phenomenology does not restrict the essence to the context of the phenomenon itself.

### Past and Current Trends

Early in the 20<sup>th</sup> century the debate of the best way to educate African Americans raged between W. E. B. Dubois (1903) and Booker T. Washington (1901). Dubois felt focus should be on the top 10% of African Americans (Franklin, 1965). The top ten percent should be educated in academics and then reach down to bring up other African Americans. Alternatively, Washington (1901) felt vocational education would best prepare African Americans for service; thus, allowing each person to bring themselves up (Franklin, 1965).

Over the next century, many reforms were implemented that address schooling; some being macro in nature while others operate on a micro level (Singer, Beasley & Bauer, 1997; Murayama, Elliot, & Yamagata, 2011; Thompson & Lewis, 2005; Patrick, Kaplan, & Ryan, 2011; Cook, 2006; Ballon, 2008; Moreno, Ozogul & Reisslein, 2011; Cole-Henderson, 2000; Ikpa, 2003; Sheppard; 2006). Examples of macro reforms were federal mandates to desegregate and district mandates to transform the structure local schools through magnet programs, pullout programs, small schools, schools-within-schools or smaller learning communities and residential programs. Micro reforms resided at the classroom level. Those include included various student-centered pedagogical models such as problem-based learning and STEM-designed challenges (Barland, Martin, Ko, Peacock, and Rudolph, 2013; Barland, 2013).

I emphasize the focus of this study was to arrive at the essence of how African American males navigate high school and go on to major in STEM fields; therefore, this

study sought to analyze data at the micro level. All other data were presented to set the scene of what the literature said and provided a comparison between the literature and this study. The use of attribution theory as a theoretical framework and phenomenological case study as a methodology allowed informants the flexibility to ascribe their ability to pursue STEM degrees to either macro- or micro- experiences.

## Chapter 2

### LITERATURE REVIEW

#### Introduction

A traditional literature review would begin with scholarly accounts of the failures and inadequacies of African American males in high school. They would then draw a comparison or make the argument that more stories of successful African American males are needed and then cite scholarly work that does just that. It was my contention that any further inclusion of deficient oriented research added to the diatribe (Harper, 2012; Matthews, 2005). I caution that my decision not to include such negative discourse was not to presume that African American males have somehow reached the pinnacle or crest of change when it comes to the perception of African American males in science, technology, engineering and mathematics (STEM) fields of study. Furthermore, the aforementioned type of literature review was not consistent with a phenomenological study (Moustakas, 1994).

Moustakas (1994) states literature reviews in phenomenological studies should review both professional and research literature related to the phenomenon. Specifically, “the investigator assesses the prior relevant studies; distinguishes their designs, methodologies, and findings from the investigator’s own study” (p. 111). This will be done in two cycles. The initial literature review compared designs and methodologies used in prior research to the design and methodology of this study. The second interview compared findings of this study to the existing body of literature.

There were four types of literature reviews that can accomplish this goal: integrative, theoretical, methodological, and thematic (Moustakas, 1994). Integrative

reviews presented current knowledge related to the phenomenon; theoretical reviews analyzed theories used to investigate phenomenon in question; methodological reviews, similar to theoretical reviews, analyzed methods use to investigate phenomenon studies, and thematic reviews organized themes derived in other studies (Moustakas, 1994). These studies were purposefully selected because they were a) diverse in the use of theoretical frameworks, b) diverse in the use of methodology, and c) current.

This literature review was somewhat eclectic in nature comprising of all four. It was integrative in nature in that the studies of African American males in mathematics are current. While a dearth of literature surrounding successful African American males in mathematics still exists, it was not my assertion the body of literature was limited to just three studies.

It was theoretical and methodological in nature as it compared theoretical frameworks and methodologies of other studies to this study. I argued the pairing of attribution theory as a theoretical framework and phenomenological case study as a methodology spawned an exceptional study that significantly added to the body of literature regarding African American males pursue STEM degrees as undergraduates. A saturation of the literature has not revealed this pairing used in previous studies.

The thematic portion of the literature review followed the summarization of the seven studies. At that time common themes found within them were itemized and contrasts between these studies and this study are stated.

This initial literature review as designed to provide a scholarly background of research that has been conducted to address this study's research question: How do undergraduate African American males who are pursuing STEM degrees describe their

experiences in high school? A second literature review was conducted following data collection and analysis. This second literature review appeared later in chapter 5 of this study to distinguish the findings of this study with the findings examined in that literature review (Moustakas, 1994).

### Summary of Current Studies

The first studies that were reviewed are a pair of studies that Berry either sole or co-authored (Berry, 2005; Berry, Thunder, & McClain, 2011). Both studies were valid for the purpose of this literature review due to the consistency across theoretical framework and methodology. In both studies critical race theory was used as a theoretical framework and phenomenology as a methodology. He rationalized his use of critical race theory as a theoretical framework because it allowed the voices of participants to be heard while simultaneously recognizing the role race and racism has played in the schooling experience of African Americans (Berry, 2005). Phenomenology was used as a methodology because it allowed the voices of the participants to be heard rather than that of the researcher.

In addition Berry (2005), explored how two successful African American middle school students experienced mathematics. The participants were interviewed three times individually as well as completed a questionnaire. Parents and teachers of these students were also interviewed as well as a document analysis of test scores and grades of the students. A descriptive portrait of each participant was created from analysis of all collected data and five themes emerged as things that contributed to their success in mathematics: 1) early positive mathematics experiences in preschool and elementary school, 2) aggregated individual discrimination through early diagnosis of ADHD and

cultural differences being construed as inappropriate behavior, 3) support systems from family and other role models, 4) drawing upon school/community resources such as church, special academic programs and sports and 5) self-empowerment exhibited through a strong ability to do mathematics, self-motivation to succeed in mathematics, positive self-esteem, and the ability to recognize a teacher who cared for them.

Later, Berry, Thunder, and McClain (2011) used critical race theory and phenomenology to explore how thirty-two rising fifth through seventh grade boys defined themselves as mathematically successful. The study was set in a two-week long summer program focusing on algebraic reasoning and problem solving. Specifically, how they viewed their personal ability to do mathematics, how significant was mathematical knowledge, identified openings and blockades to enter mathematics related fields and what has motivated them to persist to be successful in mathematics.

What they found through one 45 minute focus group interview that was videotaped and transcribed, autobiographies, document analysis of grades, test scores and teacher comments, and observations where several factors that positively contributed to their mathematical identities. Those factors were computational fluency by third grade, positive relationships between teachers, families, out-of school activities, extrinsic recognition through tracking, test score, gifted classification, and pride that associated with a complex subject such as mathematics. Furthermore, they found participants felt teachers treated groups of students differently based on race, gender, etc. and they somehow internalized these feelings a developed a sense of “otherness” between them and other African American males.

The majority of Harper's work focused on African Americans experience on the collegiate level (Harper, 2007, 2010; Harper & Griffin, 2010). He sought to find something beyond common themes found in studies that focus on African Americans in college: racism and stereotypes of African American on predominately white campuses, how race-specific programs help to reduce racism and stereotypes, and how Historically Black Colleges and Universities (HBCU) have traditionally provided a more nurturing environment for African American students (Harper, 2007). His frustration resided in the common use of quantitative methodologies that resulted in these findings. He stated these measures lack "...depth, complexity, personal accountability, and voice (Harper, 2007; p. 56)".

In his study of over 219 African American male students at forty-two colleges and universities in twenty states, Harper used trajectory analysis as a means of not adding to the deficient oriented body of literature (Harper, 2007, 2010, 2012; Harper & Griffin, 2010). This framework was used to investigate how participants gained access to their current college or university, avoided common hurdles while in college, and constructed impressive portfolios that make them competitive for admission into graduate or professional schools.

Findings from the study included reasons as to how African-Americans gained access to college (Harper, 2012; Harper & Griffin, 2010). Those reasons were at least one influential teacher (Harper, 2012) and they were prepared for college during high school (Harper, 2010, 2012). Participants in the study constantly faced accusation from their Whites peers that African Americans were only admitted via affirmative action. Three programs that appeared most often that perpetuates this notion are Prep for Prep

([www.prepforprep.org](http://www.prepforprep.org)), The Posse Foundation ([www.possefoundation.org](http://www.possefoundation.org)), and Stanford University ([www.stanford.edu/dept/finaid](http://www.stanford.edu/dept/finaid)) (Harper & Griffin, 2010).

Participants in this study found that being accepted into these prestigious colleges and universities was not enough. They attributed their enrollment into such schools to the financial aid aspect of these programs; therefore, the study suggested that more should be done to increase awareness of programs like these as well as others. Furthermore, the study noted the shortcomings of these programs as limited resources and suggested state legislators to make funds available to low-income students, not just African-American, to attend these schools.

Additionally, students spoke of programs that prepared them for college while still in high school. These programs were not affiliated with their high school. Detroit Area Pre-College Engineering Program, the University of Michigan Summer Engineering Academy and the Minority Introduction to Engineering and Science Program at Massachusetts Institute of Technology were a few of the programs the participants mentioned. Regardless of the specifics, the fact remained that they were exposed to programs outside of the regular school setting that specifically prepared them for the college going experience. Overall, these programs were found by parents who constantly pushed the notion of college as a means of social success (Harper, 2012).

Stinson (2004) used critical postmodern theoretical framework paired with a participatory action research methodology to explore four mathematically successful African American students from a magnet school. Critical postmodern theory was a somewhat eclectic (Stinson, 2004) theoretical framework comprised of poststructural, critical race, and critical theories. These frameworks were selected because they

complement each other while at the same time address different aspects of the study. Poststructural theory provided a frame for rethinking and redefining key concepts such as person, agency, and power among others. Critical race theory provided a frame for understanding how the discourse of race and racism operates within United States social structures. Lastly, critical (postmodern) theory provided a frame for discussing what should be the purposes of education research.

When selecting a methodology, Stinson (2004) paid close attention to how it would fit with his eclectic theoretical framework. In the end, participatory action research was used to study these four successful African American males. As he defined what participatory action research was, it became obvious that his marriage between theoretical framework and methodology worked well together. It was critical in nature due to the tenet of questioning the established culture. A critical race component of participatory action research was an emancipatory process that aims to free participants from unjust social constructs. Finally, it was poststructural in nature by causing participants to question their sense of identity and agency.

Participants in the study were four African American males who successfully passed Advanced Placement Calculus or Advanced Placement Statistics or successfully passed a joint enrollment calculus or statistics course, and scored in the top 25% on the mathematics portion of the SAT. Through analysis of interviews and written artifacts, Stinson (2004) found participants defined success as either positively effecting change or in terms of living a happy life; found that the usefulness of mathematics went far beyond school and their access to mathematics was not restricted; and they possessed an acute awareness of negative discourses regarding African American males dress and academic

deficiency yet managed not to succumb to the pressure by limiting its effects or using it as motivation to succeed.

The overarching themes that arose in all studies mentioned were the role of parents and early academic experiences. Berry (2005) indicated that it was because of the lack of trust with the school that parents had to serve as "...protectors, supports, and advocates" (p. 57) for their sons. Findings from the same study indicated that parent's ability to assist in helping with the mathematics played a big part in their student's success.

#### Contrast to Current Studies

In both studies conducted by Berry, the author focused on middle school aged African American males. This dissertation was different from Berry as it focused on four African American high school males. Also, I used interviews, a traditional method associated with phenomenology, as the sole data collecting technique (Moustakas, 1994; Schram, 2006) rather than Berry's (2005) choice to use questionnaires, document analysis in addition to interviews as methods. Moreover, Berry's interviews were not limited to the participants. He interviewed the parents and teachers of the participants to gather perception data.

My choice of theoretical framework, attribution theory, was selected purely to provide a structured system for my participants to accurately ascribe their ability to navigate secondary school and continue their education in college by pursuing a STEM related degree. Furthermore, the pairing of attribution theory as a theoretical framework and phenomenological case study as a methodology further removed my predetermined

notions as a researcher by requiring me to bracket those ideals that are related to the phenomenon being studied.

Although my study took elements from all studies mentioned earlier, it was most similar to work done by Harper (2012). He consistently uses phenomenology as his methodology and interviews as a method. Different from Harper is the setting in which his research takes place. Rather than focus on students' environment once they've reached the collegiate level, this study focused on the intentional reflection of experiences at the secondary level now that they are now in college. It was the intention of this study that when the story of African American males pursuing STEM degrees were better understood in high school, then a reduction in the "...population for whom college participation, persistence, and achievement appear most problematic" (Harper, 2007, p. 59).

All of these authors write in a point of view of achievement (or success). Harper (2010) notes there is a plethora of studies whose focus is on the lack of achievement of African Americans in science, technology, engineering and mathematics, but very little has been written about those who persist. Harper's work provided an anti-deficit achievement framework for future research on African-Americans throughout their schooling years (Harper, 2010). Using phenomenology as a theoretical framework and trajectory analysis as a methodology, he looked nationally at undergraduate African Americans who successfully persist through negative statistics and attain STEM related degrees across various types of campuses. Attribution theory was the framework I chose to use when looking at African American males who successful completed a STEM themed magnet program and chose to pursue a STEM related degree. Furthermore,

Harper divided the STEM pipeline into three intervals: pre-college socialization and readiness, college achievement, and post-college persistence in STEM.

This study resided in the pre-college socialization and readiness realm. Harper (2010) further divided this category into three subgroups that students may subscribe as possible reasons they were adequately prepared for college: familial factors, K-12 forces, and out-of-school college prep experiences. The use attribution theory allowed, participants of this study ascribed to these same subcategories and created new ones not included in this study.

I chose not to use anti-deficit theoretical frameworks such as critical race theory because it inherently recognizes the role racism played in schooling (Berry, 2005). I do not deny the fact that racial tension existed in the schooling of African Americans; however, I believe this was a direct contradiction to my methodology of phenomenological case study. Using phenomenological case study, I wanted the voices of my participants to truly be heard rather than a proliferation of the established literature of the burden of racism. If the theme of racism arose from my participants; it would be included in the analysis. If race prove to be an essence, it will be examined further in the second literature review.

## Chapter 3

### METHODOLOGY

This study used phenomenological case study as the methodology to address the following research question: How do undergraduate African American males who are pursuing STEM degrees describe their experiences in high school? In contrast to other methodologies such as ethnography, a phenomenological case study was most appropriate for this research question because of its ability to highlight the voices of the participants.

#### Phenomenology

Phenomenology has morphed into various forms, but Edmund Husserl developed classical phenomenology over 100 years ago (Grbich, 2007; Schram, 2006). Although a trained mathematician, he found scientific procedures inappropriate when studying humans due to unstable attributes such as values and morals (McPhail, 1995; Lindseth & Norberg, 2004). Phenomenology attempted to go beyond the “life-world” or “one’s ordinary conscious experience” (Schram, 2006, p. 99) to the “hidden meaning and essence” (Grbich, 2007, p 84) of the experience. Lindseth and Norberg (2004) explained meaning making of lived experiences in the ordinary world reveals the essence of the lived experience.

Phenomenology sought to understand how individuals make sense of lived experiences through its central concept – “being-in-the-world”- which implied that the mind and body, lived experiences, and historical/social context were interwoven (Lindseth & Norberg, 2004; Standing, 2009). When phenomenology is used, it is

important to begin with the perception of the participants by allowing them to describe and derive meaning of a phenomenon (Schram, 2006).

The essence of a lived experience could only be constructed through an individual's perception of a significant lived experience (Standing, 2009); thus, phenomenological studies were told in a manner to give voice to the participants and not that of the researcher (Schram, 2006). The role of the researcher was to find commonalities or themes among participants and discover what was essential to the phenomenon regardless of the individual (Lindseth & Norberg, 2004; Schram, 2006).

Phenomenologists were required to bracket their understanding of the phenomenon so the voice of the participants is clearly heard without bias (Creswell, 2003; Lindseth & Norberg, 2004; Moustakas, 1994). The process of bracketing one's worldview as not to distort the true essence of the phenomenon being examined was called phenomenological reduction (Grbich, 2007) or epoche' (Lindseth & Norberg, 2004; Lovat, 2001; Schram, 2006). Grbich (2007) offered four steps for phenomenological reduction: 1) identify the phenomenon, 2) identify a recent experience of your own related to the experience, 3) take certain varied features of the experience and delete it, and 4) continue until arrived at the essence.

Lindseth and Norberg (2004) stated this is best done through narration of the lived experience as to refrain from drawing conclusions before hearing participants. The following is my bracketing of the phenomenon of being an African American male who pursued a STEM degree as an undergraduate at a private Historically Black College and University; each cycle of the phenomenological reduction process was conducted and

completed prior to interviewing the four African American males who opted to participate in this study.

### Bracketing My Position

I grew up in a middle class suburban neighborhood just west of a large urban city in southeast United States. The neighborhood was comprised of mostly African Americans and the majority of my friends were of single parent households where the mother was the head of household. I, on the other hand, was from a two parent household whose marriage has lasted over forty years despite tough financial difficulties.

My father never graduated from high school and my mother earned an associate's degree in nursing. Together they ventured into the mortuary business based on my father's experience working in the industry early in his life. The business experienced peaks and valleys of success before finally collapsing in the great recession. My parents always encouraged me to do well in school. My father emphasized the need to acquire as much mathematical knowledge as possible. Although my father never graduated from high school, he understood mathematics as a gateway to higher education.

Despite my neighborhood comprising of mostly African Americans, my high school was majority European American. I took all honors level courses – except in mathematics. Placement in honors mathematics was based on placement into Algebra I in the eighth grade. I took regular eighth grade mathematics and was not granted access to upper level mathematics during my high school career; nor did anyone push me to do so.

Not having access to upper level mathematics in high school did not hinder my performance in the mathematics class I did take. In fact, I was involved in a teacher

cadet program my senior year that resembled that of the student-teaching that one would experience when pursuing teaching certification. I taught mathematics to fifth graders at a local elementary school and geometry to sophomores in my high school. It was through my teaching of mathematics that I began to have a deep understanding of mathematics. Despite this deep understanding of mathematical concepts, I was still forced to enroll into College Algebra my freshman year in college even though I was majoring in mathematics and the first course on the program of study is Calculus I.

I attended a private Historically Black College and University (HBCU) near the downtown area of a large urban city in the southeast United States. I was fortunate to have a professor for College Algebra that quickly recognized my deep understanding of mathematics and inquired about my major. She took me directly to the registrar's office and dropped College Algebra and enrolled me in Calculus I once she realized that I was majoring in mathematics. It was amazing that a college professor saw and reacted in two weeks to what none of my high school teachers or counselors ever recognized in four years.

Upon graduating from college I enrolled in a Masters in Mathematics Education program at a predominately White college in the same urban city in southeast United States. I distinctly remember questioning my mathematical ability the first day I entered into my Transformational Geometry class. This was the first class I had taken with majority European Americans since high school and this was the first mathematics class that was taught primarily through technology; specifically, Geometer's Sketchpad. After only a few sessions, my confidence returned as I found myself tutoring my classmates.

Some of the students I tutored were over fifteen years my senior. I went on to earn a Specialist in Mathematics Education from the same institution.

My 13 year career in education began as a teacher of mathematics in a magnet school whose theme is centered about mathematics and sciences. After five years, I was promoted into administration at the same school. Although I rarely use the formal mathematics that I learned in school, I still use the essence of my experience with mathematics. That is the ability to confidently think critically to solve problems given a set of rules that constrain the situation.

The essence of my experience with entry into college and pursuing a degree in mathematics was positively influenced by my family; specifically, my parents who demonstrated the tenacity to stay together not only for the kids but for each other even through the tough times. If it was not for my parents pushing me to do well in school and go on to college, I probably would still be with my high school classmates who never went to college and currently working dead-end jobs with multiple children born out of wedlock.

### Case Study

Case study was an in-depth research methodology in which the researcher collected details from a program, an event, a process, an individual or set of individuals over a sustained period of time (Creswell, 2003; McMillan & Schumacher, 2006). It could be an analysis of single or multiple cases (David, 2007). Using a common case protocol was essential when using a multiple case study for single or team of researchers (Yin, 2002). The benefit of utilizing the same procedures and methods was to avoid “uneven results” (p. 54).

Case study was not an analysis of a program, an event, a process, an individual or set of individuals in their entirety; rather, it was intended to focus on a particular facet (Mohd Noor, 2008). This was done by bounding the case by time and a specific element of an event or phenomenon (Creswell, 2003; McMillan & Schumacher, 2006; & Schram, 2006). The bounding of a phenomenon was essential to avoid analysis to too many variables making the research useless (Yin, 1981). The researcher defined the boundary of the case (McMillan & Schumacher, 2006).

Schram (2006) asserted case study was a practical methodology in qualitative research for three reasons: intrinsic, instrumental, and collective. Intrinsic implied the case itself is of interest, instrumental case studies helped to understand something else, and collective cases studies extended multiple instrumental case studies to move toward a better understanding of a phenomenon. Yin (1984) rephrased this in his three types of qualitative research as exploratory, descriptive and explanatory respectfully.

Case studies were empirical inquiries that investigates phenomenon using multiple methods of data collection (Mohd Noor, 2008). Its diversity made it applicable to both quantitative and qualitative research (Yin, 1981). Yin (1984) said case study was the “implicit companion” (p. 58) of qualitative analysis. Thus, case study could be used in conjunction with other qualitative strategies of inquiry such as ethnography, narrative, grounded theory, and phenomenology. Methods for data collection for case studies were varied including, fieldwork, archival records, interviews, or observations (Creswell, 2003; McMillan & Schumacher, 2006; Yin, 1981). Key features of a case study wew chronology and vignettes (Yin, 2002).

## Phenomenological Case Study

Case study was a common methodology for phenomenological studies. It possessed the ability to examine phenomenon in a context where the connection between phenomenon and boundary is not clearly evident (Yin, 1981). The “not clearly evident” is a direct connection to phenomenology that seeks the essence of a phenomenon, which is also not clearly evident. Phenomenology increased the understanding of lived experiences and case studies promoted better understanding of a phenomenon to make informed decisions (McMillan & Schumacher, 2006).

The use of multiple case studies was especially useful in phenomenological studies that seek the essence of a phenomenon that is fundamental to the event regardless of the individual. Case study protocol increased validity of the true essence of the event. There were two approaches to analyze multiple case studies: case-survey and case-comparison (Yin, 1981). The case-survey approach was most applicable when using case study in quantitative research due to the requirements of variable isolation and large sample size. Case-comparison looked for similarities that were common in all cases as well as highlight what is different.

I used the common case protocol for this multi-case study to investigate the phenomenon of four African American males who pursued science, technology, engineering and mathematics (STEM) degrees as undergraduates. I chose multi-case versus single case in an effort to get to the true essence of the phenomenon that was fundamental to the phenomenon and not unique to the individual. I offered several attribution interventions in chapter 6 of this study in an effort to increase the number African American males going to college and earning STEM degrees; thus, the study is

instrumental or explanatory in nature. I used the case-comparison approach to analyze the data after completion of data collection from the multiple cases.

David (2007) offered six steps for conducting case study: 1) start with the problem, 2) state the objective, 3) define the case and collect data, 4) analyze data, 5) link results to objective and 6) state conclusions. The first two and a portion of the third step were completed in chapters 1, 2 and 3 of this study. The problem was identified in chapter 1 of this study by listing a plethora of descriptive statistics that highlight the need to increase the number of African American males pursuing STEM related degree. The objective, or research question, that drove this study was also stated in chapter 1: How do undergraduate African American males who are pursuing STEM degrees describe their experiences in high school? The case that was subject to analysis is that of four African American males currently pursuing STEM related degrees. The next steps were to collect and analyze data (chapter 4) and used that data to answer the research questions and draw conclusion (chapter 6).

Both phenomenology and case study began with little conceptual framework, but required a theoretical framework to derive research questions that bound the study and should be flexible throughout (Yin, 1981). A case study examined a bounded system or phenomenon that is defined by the researcher (McMillan & Schumacher, 2006). My study was defined as a phenomenological case study that sought to discover the essence of the lived experience of four African American males who are currently earning a STEM degree as undergraduates and attribution theory is the flexible theory that is used throughout data collection and analysis. Using interviews as my method, I collected data

from four participants over a twelve-month period. Member checking was used to increase validity.

### Participant Selection

The type of sampling method used in this study was purposeful sampling. Purposeful sampling was the main idea of qualitative research where the researcher actively seeks informants who experience the phenomenon under investigation (Creswell, 2003; McMillan & Schumacher, 2006). The criteria for sampling participants in this phenomenological case study were as follows: 1) an African American male, 2) currently enrolled in college and pursuing a STEM degree, 3) willingness to participate in a one-on-one interview for at least 60 minutes with me as well as several untimed interviews following transcription and analysis of the initial interview, and 4) willingness for the interview to be tape-recorded, and results of the study to be published. This criterion was consistent with Moustakas (1994) requirements for participant selection in phenomenological studies.

### Method

Method was defined as “the working vocabulary of research procedure” (Gubrium and Holstein, 1997, p. 3). Moustakas (1994) stated that phenomenology as a methodology occurs in three phases: preparation, data collection, and organizing and analysis of data. Preparation began with the clear articulation of a research question with social meaning and personal significance. This was done in chapter 1 with the development of the research question: How do undergraduate African American males who are pursuing STEM degrees describe their experiences in high school? Another component of preparation was the completion of an initial phenomenological literature

review; this was done in chapter 2. The following is a detail explanation of the second phase of phenomenological methodology: data collection.

#### Instrument

Interviews were the traditional data collection method used in phenomenological studies (Moustakas, 1994) and were the sole data collection method for this study.

Interviews were intended to provide an opportunity for participants to express their views and opinions through open-ended questions (Creswell, 2003; Moustakas, 1994). It intended to gain the participants worldview prior to scientific explanations (Kvale and Brinkmann, 2009). Kvale and Brinkmann (2009) focused on a particular type of interview that is defined as “an interview with the purpose of obtaining descriptions of the life world and the interviewee in order to interpret the meaning of the described phenomena” (p. 3). This type of interview was congruent to phenomenology that sought to discover the essence of a phenomenon from the participant’s point of view (Moustakas, 1994; Schram, 2006). In fact, Kvale and Brinkmann (2009) said this type of interview was “inspired by phenomenology” (p. 14).

Researchers who conducted a phenomenological study may enter into the interview with predetermined questions related to the phenomenon, but they can be “varied, altered, or not used at all when the [informant] shares the full story of his or her experience” of the phenomenon (Moustakas, 1994, p. 114). The application of attribution theory as a theoretical framework provided me a systematic process to analyze informant’s ascriptions as to what led them to pursue STEM degrees as undergraduates. The semi-structured nature of the questions allowed participants to speak on topics outside of the questions contained in the common case protocol of the initial interview.

Second coding of transcripts from the initial interview using attribution theory facilitated the creation of questions that were asked in follow-up interviews in an effort to fill in gaps of the attribution theory process.

The use of interviews as a method also worked well with the use of case study as a methodology. Kvale and Brinkman (2009) listed twelve aspects of an interview. Among them, two were directly related to case study: specificity and focused. Specificity was the description of a particular event and focus on looking at particular themes. This correlates to case study which was a study of a particular facet of a phenomenon [specificity] and was bounded by time and specific element of the phenomenon [focus] (Mohd Noor, 2008; Creswell, 2003; McMillan & Schumacher, 2006; & Schram, 2006).

Creswell (2003) noted the limitations of interviews are 1) information is filtered through the participants, 2) researcher bias may be present, and 3) people aren't equally articulate and perceptive. I argued the first limitation is actually an advantage to the chosen methodology of phenomenological case study that sought to find the essence of a phenomenon and that essence can only be derived from the person experiencing the phenomenon (Moustakas, 1994). Phenomenology endeavored to limit researcher bias by requiring the research to bracket their position regarding the phenomenon being studied (Moustakas, 1994). This bracketing was completed earlier in this chapter. Attribution theory mitigated the third limitation by providing a systematic method of reflection to identify those things that contribute to the phenomenon in question (Weiner, 1985). The third phase of phenomenological method, organization and data analysis, was conducted upon completion of phase two (chapter 4).

The analysis of qualitative data was ongoing and required techniques that go beyond generic approaches (Creswell, 2003). Interviews were transcribed and coded. Coding was a systematic arrangement of data in order to categorize (Saldana, 2009). The purpose of coding was to move from the abstract to concrete; in other words, from codes to themes. A theme was a phrase or sentence that identifies what a unit of data is about and what it means (Saldana, 2009). The process of theming data allowed me to analyze transcriptions and arrive at the essence of the phenomenon of African American males pursuing STEM degrees as undergraduates. Van Manen (1990) supported this when he described how themes serve phenomenology at the latent level:

The study of the life-world - the world as we immediately experience it - pre-reflectively rather than as we conceptualize, categorize, and reflect on it.

Phenomenology aims at gaining a deeper understanding of the nature or meaning of our everyday experiences (van Manen, 1990, p. 9)

Saldana (2009) indicated there are two cycles of coding. First cycle coding were processes that happened in initial coding and second cycle are a bit more challenging and moves data from abstract to concrete. There are seven categories of first cycle coding which encompasses twenty-two techniques. I used three first cycle coding techniques to codify transcriptions. Second cycle coding was not always needed and its purpose is to reorganize and reanalyze first cycle coded data (Saldana, 2009). I did not use a second cycle coding technique do to my choice to use multiple first cycle techniques.

The three first coding techniques that were employed in this study were simultaneous, structural, and initial coding (Saldana, 2009). Simultaneous coding was applicable when using two or more different codes (Saldana, 2009), structural coding was

used when using semi-structured data gathering protocols are used such as semi-structured interviews (Saldana, 2009); and initial coding which was used to breakdown down qualitative data into discrete parts where the goal is to “remain open to all possible theoretical” possibilities (Strauss and Corbin, 1998, p. 102 in Saldana, 2009). All three coding techniques were aligned with the theoretical framework, attribution theory (Weiner, 1985), and methodology, phenomenological case study (Moustakas, 1994), used in this study.

### Ethical Considerations

Kvale and Brinkmann (2009) said ethical issues can occur at any of the seven stages of research. In order for knowledge to be produced from an interview, there must be trust between interviewer and interviewee that what is said is accurate through the point of view of the interviewee (Kvale and Brinkmann, 2009). A common method to increase the accuracy of interpretation is member checking (Schram, 2006). Member checking is the process of allowing participants access to analysis of data to check it prior to publishing. I will employ this technique after the analysis and synthesis of data from transcribed interviews to ensure accurate interpretation. To protect the identity of informants, pseudonyms were chosen by the informants.

## CHAPTER 4

### DATA REPRESENTATION

#### Framework

This chapter was the third phase of phenomenology research which was the organization and analysis of data (Moustakas, 1994). This chapter was divided into three categories. The first section described the school in which these four African American males attended and what the researcher states about this type of school. Next were detailed descriptions of the four African American males themselves. The chapter concluded with the analysis of the data organized using subcategories of attribution theory: outcome, outcome dependent affect, causal antecedents, causal ascriptions, casual dimensions, psychological consequences and behavioral consequences.

The one-direction flow of the attribution theory model helped to clear the “murkiness” of phenomenology. Some of the quotes from the participants’ stories reappear during the analysis to provide evidence of relevance for the particular section in which it appears. This was all done to answer the research question guiding this study: In what ways do undergraduate African-American males who are pursuing STEM degrees describe their experiences in high school?

#### The School

At the time these students were in high school, their school was a selective magnet program whose theme was science and mathematics. In order for them to be eligible for admittance, candidates were required to have high GPAs, teacher recommendations, and write essays. The school is no longer selective in the sense that students must meet certain criteria to attend. It is simply a school-within-a-school for

students who live in the school's attendance zone. The program of study and academic rigor; however, has not changed. The following section is a review of the benefits of STEM themed high schools as it relates to promoting African American males to pursue STEM degrees as undergraduates.

In response to The America Creating Opportunities to Meaningfully Promote Excellence in Technology, Engineering, and Science (COMPETES) Act of 2007, President Obama announced in 2010 his plan to federally support 1,000 specialized science, technology, engineering and mathematics (STEM) high schools (Tofel-Grel and Callahan, 2014). Despite the surge in interest in STEM themed high school, no clear definition of what a STEM high school was currently existed (Tofel-Grel and Callahan, 2014; Hansen, 2013).

STEM schools were categorized in two ways; structure and enrollment practices. The most common structures were schools-within-schools, pullout programs, stand-alone schools, residential schools, university-based schools, full-time commuter, and half-day (Tofel-Grel and Callahan, 2014; Subotnik, Tai, Almarode, Crowe, 2013). Enrollment or admission practices were either selective or non-selective (Subotnik, Tai, Almarode, Crowe, 2013). Non-selective schools tended to have a wider range of demographics to include African Americans in effort to develop students' STEM aptitude than selective schools (Hansen, 2013). Furthermore, selective schools tended to be schools of choice and clustered in only a few states and metropolitan cities, but have the tendency to partner with more local universities, museums and business community to provide a more rich learning experience and offer more advanced science and mathematics classes (Subotnik, Tai, Almarode, Crowe, 2013).

Tofel-Grel and Callahan (2014) sought out to examine the effectiveness of STEM schools in comparison to traditional schools that offered rigorous STEM courses in their program of study. They used constructivism as a framework to gather the lived experiences from school stakeholders to answer their two research questions: 1) What are the common and unique features of STEM schools and 2) In what ways does the model type affect the perceived experiences and learning opportunities from the perspective of teachers, students and administrators.

These authors used the list of STEM schools provided by the National Consortium for Specialized Secondary Schools of Mathematics, Science and Technology (NCSSSMST) (142) and searches from all fifty state departments of education websites (216) to create a pool of 358 total schools. Using purposeful sampling, six schools were examined. The selection criteria were created in such a way to cover the various structures, span different regions across the country and varying enrollment sizes.

Their method for data collection included observations from eighty-six STEM classrooms focusing on instructional practices, semi-structured individual and focus group interviews that lasted approximately sixty minutes, review of school websites, and program documents including the school's mission, sample lesson plans, labs, curriculum development, admissions, hiring practices, student performance, and district-level policies that affect practices at the school level.

Through their initial analysis, they found eleven themes that emerged. Those were culture, testing, intelligence, teacher workload, inquiry-based learning, research projects, authentic of science experiences, student workload, independent learning, critical thinking, and argumentation. After secondary coding and discussion among the

authors, four larger themes remained: 1) a common social and intellectual culture, 2) the role of the research experience, 3) the role of the inquiry model, and 4) the value placed on independent learning and personal responsibility. Additionally, the structure of the school did not appear to affect the learning environment other than the amount of time within the school day to engage in authentic learning.

Hansen (2013) followed in the examination of successful science, technology, engineering, and mathematics (STEM) schools using longitudinal data from two states: North Carolina and Texas. The data spanned from the 2006-07 to the 2008-2009 school years. The author sought out to discover if attending a STEM focused school added value to student achievement. He contended the use of longitudinal data was more accurate than cross-sectional data as the former has the ability to project student performance on future examinations based on prior assessments. By doing so, he could measure if students who attended STEM school outgain their own predicted achievement. The author cautioned that schools included in the study are selective and parent involvement, student interest in STEM, and other positive attributes may be higher than the control groups. He also added that because of this difference, students attending the selective STEM schools should significantly outperform their counterparts.

The pool of potential schools to be examined was generated from lists of STEM schools from external sources, searching websites of magnet programs with a STEM focus, and an internet search of keywords that would indicate the program was a STEM themed program. Only middle school mathematics test scores were available in Florida whereas mathematics and science scores from middle and high school were examined.

Hansen's study was a study of outliers; STEM schools that significantly outperformed the traditional counterparts and successful versus unsuccessful schools. When examining STEM vs. non-STEM schools, he found STEM schools in both states served smaller enrollments than non-STEM schools. Surprisingly, Florida, who had a high minority demographic, enrolled significantly less minorities in its STEM schools. On the other hand, North Carolina educated more minorities in its STEM schools. Additionally, the author found standardized test scores do not vary significantly. His third finding was that STEM-themed schools tended to occur at the secondary level more than middle and elementary; these schools tended to be magnet or charter schools in Florida. Finally, students in STEM schools were more likely to take advanced STEM courses.

When examining mathematics value-added, he found specialized STEM schools did not perform better than successful non-STEM schools. Second, science classroom activities positively impacted mathematics achievement. Third, schools with low teacher turnover were more successful. Interestingly, participation in advanced STEM courses was low in successful schools. Finally, to the dismay of policymakers, minority participation in STEM courses in successful schools was significantly low.

Subotnik, Tai, Almarode, and Crowe (2013) also investigated the effectiveness of science, technology, engineering and mathematics schools. Like Hansen (2013), these authors focused on selective STEM schools. They were interested in finding if these selective STEM schools increased the probability of their graduates to study STEM as undergraduates, what aspects of their instructional experience attributed them to pursue STEM, and which structure promoted STEM degree attainment.

Their study included over 1000 participants across several campuses. They found that the school-within-a-schools model was the structure that promoted the greatest percentage of students to graduate high school and pursue a STEM degree as an undergraduate and attain a STEM degree. Additional findings included that graduates of selective STEM schools participated in more research projects, mentorships or internships, and feeling accepted in the science, technology, engineering and mathematics community.

Rogers-Chapman (2014) was concerned about the limiting nature of selective science, technology, engineering, and mathematics schools. Using stratification theory as a theoretical framework, the author attempted to answer three research questions: (a) Is there a relationship between socioeconomic status and admission into non-selective or what the researcher refers to as inclusive, schools; (b) Is there a relationship in regards to race, and (c) What is the relationship of the location of these schools?

When examining the performance of STEM schools versus non-STEM schools in the same neighborhood, STEM school outperformed their counterparts the majority of the time. Surprisingly, selective schools in this study had a high percentage of African American students than non-selective schools; however, selective schools tend to have lower percentage of students with low socioeconomic status. This suggest that while selective schools enroll more African American students than non-selective school, those schools may not reach the type of African Americans that need this type of structure the most. Most inclusive STEM schools tend to be located in urban areas; therefore, more minorities will have greater access to them.

Not only were results regarding school structure and admission policies inconclusive in determining the effectiveness of STEM schools, but also the pedagogy implemented in the classrooms. Most STEM schools implemented more student-centered approaches such as project-based learning, mentorship/internship, joint enrollment with local colleges and universities and independent research that engages students in the scientific process (Tofel-Grel & Callahan, 2014; Hansen, 2013; Subotnik, Tai, Almarode, & Crowe, 2013; Barland, Martin, Ko, Peacock, & Rudolph, 2013; Barland, 2013).

The movement regarding curriculum in science, technology, engineering and mathematics schools was to have the students involved in the learning process through inquiry. Literature provided three common ways by which schools engage students through inquiry: problem-based challenges, engineering-designed challenges, and STEM-designed challenges (Barland, Martin, Ko, Peacock, and Rudolph, 2013; Barland, 2013). Problem-based challenges were complex problems where students apply scientific and mathematical knowledge being learned in the course. Engineering-designed challenges focused more on the engineering design process rather than math and science concepts. STEM-based challenges are encompassing of problem-based challenges and engineering-designed challenges where mathematical and scientific concepts are incorporated into the engineering design process.

Barland, Martin, Ko, Peacock, and Rudolph (2013) conducted a mixed methods study of over 100 students in nine engineering classes that spanned several schools in both urban and suburban areas to investigate if students were learning engineering process and if they were applying relevant science and mathematics principles in the

process. At the end of the yearlong study, they found that students learned the engineering process, but rarely applied scientific and mathematics concepts to complete the challenge.

Creating the STEM-based challenges proved to be difficult for teachers (Barland, 2013). Barland (2013) suggested taking what science teachers do in their classrooms and apply it to engineering classes. Science was of particular interest as they naturally have more engaging classes through laboratory experiments. The author provided six guiding principles to teachers when designing STEM-designed challenges: 1) contextualize all student work; 2) identify specific course and unit learning goals; 3) engage students in the engineering process from day one; 4) use the engineering design process as the instruction framework; 5) ensure science, mathematics, and technology are essential to complete the challenge; and 6) do all of these things within the framework of local schools and school districts.

A southeastern state recently launched a process that certifies schools and programs in science, technology, engineering and mathematics (STEM) schools. They provided schools with a 17 point rubric to follow if they wish to become STEM certified. The rubric did not specify the structure of the program. The structure could be a program within a school or a whole school model.

When the certification program launched, the goal was to certify 300 schools in three years. There were only ten schools that were certified at the time this study was completed: five high schools and five elementary schools. Of those, four were program and six were school structure. No urban high school had earned the distinction of STEM certification.

The school in which the four African American males attended first opened its doors in the early 1980's. A subset of the school was the science and mathematics themed magnet program. Requirements for admittance into the magnet program included high test scores from middle school, student writing samples, and recommendations from teachers and counselors. The program was viewed as the premier educational program for African Americans in the city. Its prestige rivaled that of many private schools in the area.

Alumni from the program attended schools throughout the country and have held prominent roles in both the private and public sectors. Graduates have matriculated through top-tier universities such as Cornell University, Emory University, Stanford University, and Northwestern University. Students earn some of the top scholarships their schools have to offer such as the Martin Luther King Jr. Scholarship at Emory University to national scholarships such as the Bill and Melinda Gates Scholarship and the Coca-Cola Scholarship. Former students have also held influential positions such as city councilmen, school board members, teachers, engineers, lawyers, and architects.

The core classes for students in the magnet program were organized in a specific program of study; however, their electives were a mixture of courses without a logical flow. At the time these four African American males attended the school two pathways were created that focused on the theme of the magnet program: science and mathematics. Each pathway began in the student's tenth grade. Students who matriculated on the science pathway began with Microbiology and Genetics, followed by Advanced Placement Biology, then Human Anatomy and Physiology or Forensic Science. Student who showed more interest in mathematics began their pathway with Discrete

Mathematics and Statistics, Advanced Placement Statistics, and concluded with Advanced Placement Physics. You will hear the four African American males speak of these courses and others as they share their experiences in secondary school.

### The Stories

Luke

I met Luke for all interviews at a local fast food restaurant in the summer. This was the most convenient place to meet for him as he worked five days a week as a lifeguard in the area. He told me in his first interview that he always liked to swim but began to swim competitively during his senior year. He also stated he played baseball all four years and was good at both. He said, "I received the MVP in pitching my sophomore and seniors years. I also earned MVP in swimming the only year I participated which was my senior year".

At the time of the interviews, he was nineteen years old. He had chosen to attend an urban research university. He decided to major in Biology and minor in Chemistry. He expanded upon his choice of colleges in his second interview. It was revealed that the college he currently attends was actually his last choice. He applied to four other colleges and did not attend for various reasons including him not meeting minimum testing requirements, lack of communication during the application process from admission offices, and being denied.

In a follow up interview he explained why none of his choices for college were Historically Black Colleges and Universities (HBCU). He indicated that it was in fact a conscious decision. He said, "I did not want to go to an HBCU. I went to an all-Black high school and I want some diversity." He did not specify any singular experience in

high school that deterred him from applying to a HBCU other than the fact that he had been around Black people his entire life and he wanted to experience something different.

Additionally, all of the colleges in which he applied were all inside the in the state in which he attended high school. His initial response was due to finances; he was the recipient of a state scholarship that paid a significant portion of tuition for students who had a certain GPA and remained in the state. I asked if he applied for any other scholarships and he indicated that he did not. I continued and asked if would leave the state if he was given scholarship dollars that could go across state lines. He replied, “No. I just like this state.”

Matthew

I met with Matthew in my office for his interviews. Matthew was never a top student, not by GPA or test score standards. He was a member of the magnet program, but was not recruited in the traditional way. He started his freshman year at his zone school before coming into the program:

I went to my zone school for about two weeks. I used the No Child Left Behind Act to come to my high school because my zone school was considered a failing school. I think I went to this school because my older brothers went to this school and always heard them talk good about it. At first I was not able to get in because there was no room in the magnet program. That is the program that I wanted to be in. So after a while of sitting at the house, I got a call saying that I’ve been accepted in the magnet program.

He lacked maturity during his freshmen and sophomore years, but something occurred during his junior year when it just clicked for him. He reflected on his maturation process during his first interview. He said, “When I came into ninth grade in high school I was not focused on school. Even though I did my work I did not do the best I could do”. He stated:

I thought my high school experience was everything that I thought it would be. It was fun, but at the same time I learned a lot. I matured as a man from ninth grade to twelfth grade. I feel like the people that I came in contact with, mentors, peers, teachers, and administrators, all helped me throughout my high school life and made me the person that I am now.

Mathew spoke several times in his first interview about being a man. I asked him during a follow up interview for his definition of being a man. He said:

My definition of being a man is taking up for your own responsibility, being accountable for myself, being able to support the things that I need first and being able to help others who are under me such as my little brothers and my nephews. Being able to show them and help them grow up to be successful people similar to how my grandmother and other successful people helped me to grow up. I think being a man is a process because the same way when people reach twenty-one years old they say that they are an adult, but I think that you are an adult whenever you have the ability to take care of your own. Being a man is a process to me. You’re constantly making steps. Those steps include your maturation in your own body and being able to help others. You have to take care of yourself before you can take care of others.

Matthew mentioned earlier that the school he attended was not his home school. I inquired about the neighborhood in which he was raised. When he spoke about his home environment, he said:

Well, my environment is what I guess you would call the hood. Most people in my environment probably went to school and may have graduated but did not do anything beyond that. They just sit there and they may have a plain job. They may sell drugs. We have people to sell drugs in my neighborhood. We have people that go to jail. I have people in my family who are in jail and others who are just sitting around. I view the bad and the good. For me to stay out of my environment and to stay out of the streets I played soccer. I was introduced to soccer from my Boys Scout leader because he did not want me in the streets. My grandmother always said that being in the streets would not help me in school. So soccer helped to keep me out of the streets and also help to mature me as a person. In my environment you have those people who come across every day. People that move into your neighborhood and then move out, but they have the ability to impact your life either one way or the other. That's how you learn how not to do this or how not to hang out with that person. You see another person doing good so you want to surround yourself around the good aspects of someone. In my neighborhood you are shown the reality. That is the reality of life. You see the bad of it and how it can be good. I don't want the bad so I chose a different route which is school and to further my education. To have the life that my grandparents didn't have and wanted me to have. I chose to take responsibility to my opportunities that were given to me.

When he came home for holidays or other school breaks, he still stayed in the same neighborhood. He explained why he stayed in his old neighborhood even though he could stay other places when he returns to the city:

It's actually a good thing. When I come home you see the same people who have been sitting around the neighborhood for years and they encouraged me to stay in college because they know that they should have done it. They see their mistakes and it's good to hear that because you don't want to follow their track. So it is good to always hear that. At the same time, when I come home I get a feeling a pity. I feel like if I make small mistakes that this is where I will be. I don't want to stay in my neighborhood the entire time I'm home. That's why I work so that I can keep away from it because I don't want to be a product of my environment.

Matthew mentioned God without provocation several times in his first interview.

I asked him to elaborate in his second interview. He was more than happy to expound:

First, I believe in God, but.... I'm a member of a church around the corner from where I went to high school, but I've gone to so many churches and have heard so many things about the Bible when these preachers speak. I believe that there is a higher power. I pray to God and I believe that..... Evolution is real but something had to be present for evolution to happen. So, I believe in God and I am a Christian but at the same time I have to choose my own personal thoughts because I've heard so many things about God and other gods so it can confuse you. So you have to infuse your personal beliefs into what you hear in order to understand what's going on. Things like when growing up you hear about war or gay marriage and things like that. I hear things like God made me do that. When

I was in Sunday school they would talk about sins. They would say it is a sin to kill. But when you study the various wars, they would say that they are killing for God. I'm not against gay marriage nor am I against gay people, but at the same time, God wants people to create new life and if you are gay then you cannot create new life. All you can do is adopting. I'm not against it by but at the same time I put my own thoughts together about it. I put my own thoughts together about the Bible and what I've learned in my life, but at the same time I still believe in God.

Matthew lost his mother early in his life. I asked how it was like to be without a mother and who helped to fill in the maternal void in his life. He offered several persons who filled in as a substitute in that role:

My mother is deceased and my dad is not really in my life. I've had temporary parents throughout my life like my grandmother. I have friends whose mother serves as mother figures in my life. And I had my soccer mom. They always gave me a choice. If I wanted to do something they supported. They would give me the bad and the good things about it but ultimately supported whatever my decision was. They always gave me a choice in what I wanted to do. They never just told me no.

He told me that he never officially asked anyone to be his mentor, but he would watch people and take the good traits. Two people he spoke about specifically were his brothers. They both attended the same high school as Matthew and have the same view of education as his mother figures. One of his brothers recently graduated from a rural

state school with a STEM degree. I asked him to speak on his brothers some more in a follow up interview. He said:

He graduated with a biology degree. He has a passion for science and mathematics. I observe him. He changed his major to biology from engineering while he was in college. When I look at him I say to myself that if he can do it then I can do it. There is no difference between me and him. There is no wall between us. He and I share the same story.

The acknowledgment or recognition he received from his brothers was greater than anyone else. It made him feel like he was successful and on the right path.

In addition to the adults he came into contact with through his high school career, He also spoke about programs that he participated in as experiences that matured him:

I chose to participate in soccer, football, and chemistry club while in high school. I've been playing soccer since I was in the fifth grade. Soccer has always been my passion. I played football, but I will put soccer over anything. At first I really didn't think much about it (chemistry club) but then I figured that I may be able to get something out of it because I was taking chemistry at the time. The study groups and being with the actual teacher more helped me to be successful in the class.

He stated that he was successful at all three extracurricular activities, but he spoke specially about soccer maturing him as a man. He says, "Working as a team helped to build leadership skills because I was captain for my other team. I was not captain of my high school team but many of the players looked up to me on the soccer team". He went on to say:

I felt like I was someone else's role model. You have to be a follower before you can be a leader. It made you feel really good. I feel like I made an impact on other people's lives. It may not be everyone I came in contact with, but there were certain people that made me feel good as a person because I was able to make them do certain things in their life. I like the feeling of being a leader and others wanted to be like me.

He was not playing soccer in college at the time of this study, but was considering playing soccer if he transferred to a different college. The school he was considering was not a HBCU and was located in an urban area. He contacted the coach at the new school. The school he was considering was located in the same city where he attended high school.

Matthew decided to attend a rural Historically Black College and University after graduating from high school. He decided to major in a STEM degree early in life. His chosen major is forensic science. His interest for forensic science was sparked prior to high school, but his relationship with his Honors Chemistry and Advanced Placement Chemistry teacher helped to solidify his decision to follow this desire:

My passion was CSI (Crime Scene Investigation), math and science. The reason why I majored in forensic science is because of TV shows I watched like CSI. Whether it was taking classes from teachers like my chemistry teacher, it really helped me to determine if I wanted to major in that area because it dealt with chemistry and calculus and things like that. She motivated me. If I wanted to do it she motivated me to do it.

John

John was able to meet me in my office for all of his interviews. This was his first time coming to the campus since the recent renovation. We took a quick walk around the school before we got started. I was able to show him how architects and engineers were able to increase the number and size of classes with basically the same footprint. He was amazed with the beauty of the school and the amount of technology readily available to students. He was proud of his school for providing additional opportunities for future generations.

He reflected on his own experience in high school and he was appreciative of the amount of resources he had at his disposal and the type of challenging classes he was exposed to while in high school. “I felt very privileged”, he said. He went on to say:

Mainly from my high school experience, I really appreciate how the door was open for me to do anything that I wanted to do. Everything was in my backyard.

I didn't have to go across town to get these opportunities. They were right here in the backyard. That is what I appreciate most.

Like most alumni who returned to the school years after graduating, he began to inquire which teachers still worked at the school as when he was there. The first teacher he asked about was his ninth grade biology teacher. He reminisced about their combustible relationship:

I've never had a problem with GPA or grades. Nothing ever challenged me to that point until I got into my freshman year in high school. My high school biology teacher has a legacy. His course is known to be challenging to freshman. It would probably be challenging to college freshmen as well. When I got into his course I was stretched to the limit. I had enough almost. At least I thought I did.

I tried to withdraw from his class. That was not going to happen. When you come to my high school everyone knows that this guy is going to be the way he is and I feel that it is intentional. Now I'm glad that it is and I hope it continues to be that way. I temporarily transferred to another school for about two weeks. I came back to this high school. My mom put me right back on track when she realized that I would not be challenged at the other school. I really appreciated that. She told me that I really needed to go back to my zone high school. When I came back I still did not take that biology teacher, but ever since then he became one of those secret mentors that when I look at him he has some qualities about himself that I need to hunker down and handle

After his ninth grade biology teacher, he asked about his favorite teacher. She taught both his Honors Chemistry and Advanced Placement Chemistry courses. He credits her for him becoming interested in STEM:

She provided me the opportunity to do research. I got a chance to do some chemistry research at a local urban college. I felt that really prepared me for college in general but especially for STEM. Science, technology, engineering and mathematics are all research base topics. So now when I go into the classroom, I'm not thinking as a student worrying about a grade. I'm more about the question. I'm constantly questioning. I'm reading about cancer and I'm reading about how there is no cure and how we're just trying to slow down the growth. I'm thinking this goes all the way back to when I was in high school when I found that we truly don't understand the cell cycle. We don't truly understand how these things control themselves. So it has turned me from a student into more of a

researcher. So when I sit in a classroom, I'm constantly question everything because of that I really enhances my grade because if there is something in the textbook or something that is accepted that I don't fully understand then I'm going to question it. It's just natural now. I question everything that is confusing. And because I question in class instead of going back home and being frustrated, I researching it and then I'll come back and be prepared for it. I really feel that my high school chemistry teacher helped me with that.

I asked him about his two parents and how they played a role in his academic process. He said:

My parents and I have a very good relationship. I live with both parents. They are both very supportive of me going to college. They understand I want to stay home. I go to a community college. They are not rough on me. They are very easy-going and I believe that contributes me to having a focused head and not stressing as much. My parents were never particular about having to get and A+ in a particular class. They are more concerned with me doing my best and that you are in the best place to get what you need. They've always done that for me. They've always looked out for me. They've always made sure that I had the opportunity to do whatever it is I need to do. I really appreciate it.

He went on to say:

Their view of education is that it is important and that education is not the only factor into success. How a person that only has a high school diploma may not be considered a success by mainstream society, but my parents have taught me that success is not always determined by how much money you make or who you do

or do not know. It is more than that. It comes down to personality. It comes down to core values and beliefs.

As a point of clarification regarding his parent's view of graduating from high school and going to college, John added:

Even though my parents don't view education as the only measure of success, I'm pretty sure that they would not be proud of me if I graduated from high school and all I did was sit at the house all day. My parents expect me to do something. Be that go out get a skill or go to college. I chose college. I think that's what they wanted me to do. I chose college. I have the bumps in the road; mainly with financial aid, so that is why I'm not going to a bigger college. So now that I'm there I'm going to make the best out of it. I think they look up to me and respect me for that because it shows resilience. Even though things don't go exactly as planned or as exactly how I wanted to go, I still made the best out of the situation and rolled with it.

He definitely felt their love and understood that both of them express how proud they were in different ways:

My parents are two different types of people. My mom will say what she is thinking. My dad is quite the opposite. If he's proud of me, then he's going to talk about me to someone else in my presence. He's not going to say that he's proud of you unless you catch him at the one particular moment of the year where he speaks like that and he would say that he's proud of you. Other than that I will always hear him telling others what all that I'm doing. That's when I know that he's proud of me. My mother on the other hand will tell me that I should do this

or I should do that. They have always prepared me to take advantage of all of the opportunities. So even when I failed myself in that manner they always have my back. My mom will come straight out and tell me that I am on the wrong track and put me back on the right track. Because of that I feel that I am on the road to success.

John was a nursing major at a local community college. He recognized that most people would not consider nursing as a science, technology, engineering, and mathematics (STEM) major, but explained why it should be. He says:

It got to a point where I knew that STEM was something for me. I knew that whatever I did would be in science, engineering, or math. Nursing is not exactly science, but there is a lot of science involved. As a matter of fact, we have to take eight science classes just for an associate degree. There are even more science classes involved when I pursue my bachelors in nursing. Science is very important for nursing.

He further justified why nursing should be considered a STEM degree due to the value of science courses in the program of study. He said:

Nursing has a lot of science prerequisites and the science prerequisites weigh heavily to determine if a nursing student gets into a nursing program, or which nursing program they get into, or whether they are on a waiting list or the first choice to get in.

In his second interview, John contrasted nursing versus a more traditional STEM degree like pre-medicine:

There are two different fields. One is patient care and the other one is medicine. Nursing is patient care. You have an entry level position in nursing that pays around \$60,000 before tax. For specialists, you're getting about \$80,000. After you get your masters, the difference of being a staff nurse and a specialist is about another year in school. I like the entire set up where you can advance as far or as little as you want. There are so many specialists. There are so many different pay grades. The money is good. The role of finances is that finances are honestly imported otherwise I would not have chosen it. I don't see myself going to college and not having an entry-level salary sufficient to the time that I've put in.

Paul

The program of study for students in the science and mathematics themed academy was extremely rigorous. Paul accepted this challenge and actively sought other challenges when he participated in summer programs and how he took numerous Advanced Placement courses that started in his sophomore year.

I was able to connect with Paul at a perfect time in his life. He stated in the first interview that he was at a point in his life where he is very reflective:

I'm at a point in my life where I self-evaluate myself each and every day. I look at the things that I have done well in terms of my study habits, how I am performing at school to meet obligations with my family and the close people in my circle. If I feel that at the end of the day that I've accomplished most of the goals, if not all of the goals, then I feel that defines success. Being able to define the challenges and obstacles that you face and be able to find the necessary steps and plan a strategy to take the necessary steps to overcome those obstacles also

helps to define success. It is not necessarily accomplishing them all at once or accomplishing them easily, because you're going to get resistance and challenges, so I believe success is more about tenacity and seeing it through to the end.

His reflections were able to give me tremendous insight into his life.

Paul was also able to complete all of his interviews in my office at the school. Unlike other participants of this study, these were not his first moments returning to the school after his graduation. He became an active member of the alumni community and worked with students in several organizations at the school including the chemistry club and the marching, symphonic and jazz bands; all of which he was a member himself while in high school. He mentioned these among other things as he reflected on his overall high school experiences when he and I connected for his first interview:

My high school experience was fun. I learned a lot. I went to my classes. I took advanced placement courses. I felt that I was challenged very much and very well at my high school. I was in the band so that was my fun aspect of high school. My extracurricular activity if you will. I was in the band starting in the eighth grade. That was the first time that the band director allowed middle school students to participate in the band. I was in the marching, jazz, and symphonic bands all the way through my senior year in high school. I was the drum major, lead drum major, so you can imagine how much fun that was for me. I was in the Student Government Association starting my junior year. I was the class president my junior year. During my senior year we were relocated to another building while our current school was being renovated. I served as the Student Government Association President during that year. It was a lot for me. I learned

a lot of things in terms of leadership and being a well-rounded student here at my high school.

Later in the first interview, Paul expounded on his participation in the band and student government association. A major influence in him being in the band was his older brother. He as his brother was only four years apart. So naturally, he would have been in the same band as his brother for one year. In an unprecedented move, the band director at the time allowed him to participate in the band while he was still in the eighth grade. Paul took pride in being a trumpet player in the trumpet section while his brother was the lead drum major.

Paul's was always a part of the student government association since elementary school. He recalled doing a "hip-hop" campaign while he was in middle school. He decided to take the first two years of high school off from the student government association so that he could get acclimated to this level of obligations. Although he took two years off, his desire to participate did not extinguish. He described his return to the student government association as "a good experience for me in terms of working with others and being able to get student initiatives done as a collective as well as the leader".

Among the things Paul mentioned he was a member during his four-year high school career, he also participated in the joint enrollment program. Joint enrollment was a partnership between school districts and local colleges and universities that allows student to take college course while still in high school. Students could use the credits earned for high school completion as well as college credits. Paul chose a major urban college to take his joint enrollment courses. He describes the joint enrollment

opportunity as “a good experience for me to get acclimated to college well before I decided to go to college”.

Paul said that he felt really good about his high school experience. He shared with me some of his thoughts immediately following graduation:

I felt that I had done everything that I wanted to do in high school. I had my fun I was still focused. I was able to find the perfect balance. To me that was gratifying because I put in the work with all of those hours doing these extracurricular activities. It was a fulfilling that gratifying feeling at graduation.

These were all meaningful experiences and it helped me to grow as an individual.

It was evident that Paul’s faith was a major part of what makes him who he is.

Without prompting, he mentioned God or his faith repeatedly during his first interview.

He first mentioned God in the first five minutes of the first interview when he spoke of challenging courses. He said:

Those times when I didn’t understand the content and did not understand why I was getting things wrong or not doing well on exams, I knew that if I prayed about it, and did the work that I needed to do that would be something that would push me over. I would understand at that point that is not all me; that everything that I am successful in or unsuccessful in is not all me. For me that was God and my faith being able to drive me to make these things happen.

He went on to say, “My mother and grandmother have raised me in my faith that I also have to have unwavering faith in things and that helps me not to become discouraged”.

In his second interview, he expounded upon his religion and faith in God. He said he and his family was a member of only one church for the majority of his life. They

actually followed the congregation as they moved from one side of town to another. He was a member of the choir, usher board, and junior deacons ever since he was in elementary school.

He recently changed churches when his old church elected to get a new pastor. I asked did he lose faith in his religion when he and his family began to seek out a new church home. He answered, “No”. He went on to talk about his experience at his new church by saying, “We fell in love with our new church the first couple of times we visited it. The minister is great”. He and his family continued their spirit of servitude in the new church by joining several organizations within the church such as the ones they were members of in their previous church.

Later in the second interview, Paul spoke about the role religion plays in his life by saying, “I feel that church is the spiritual revival that I would get every week with everything that I am involved in with school and other obligations that I have”. He and his mother spoke on the phone every morning. Together, they both thanked God for His blessings.

In the first interview he spoke about how he would stay up at night doing project for his freshman biology class. He said that only prayer got him through those nights. I inquired in the second interview had he encounter any classes since then that he feels that he had to rely on his religion to get him through. He replied there were several courses that he had to “pray his way through”. Those courses included general biology, physics, chemistry and organic chemistry. He chose to speak on physics specifically:

There was a lack of office hours after class. Additional help outside of class was pretty important because physics was a difficult course for me the first semester

and I felt that I had one of the better professors at my school. With my challenge with physics I had to rely on God because there were times that I felt that I had done everything that I could have done and it still was not enough in terms of my performance on exams and comfort level in the class itself. It really took my faith to keep me going because there are so many things that I could point to that were wrong. People rely on a lot of different things. For me it is religion.

At the conclusion of the first interview he shared two things that he feels that were vital to his success in high school. The first was the academy of which he was a member and the other was his small circle of friends who shared his level of tenacity towards success as he did. He said:

We were all in the science and mathematics academy. We came into the academy very proud because at the time we had to do an essay because it was an application process just to get admitted into the academy because at the time it was a magnet program. For us, we wore the label of being in the magnet program with pride. We were very excited to be in the science and mathematics academy. He also spoke fondly of the close relationship with his peers while in high school.

He remarked:

My peers and I were always in the same things. We were competing but it was a healthy competition. I knew that one of them wanted to do environmental science and another that wants to be an orthopedic surgeon. We would ask each other have you looked into this program or have you looked into that program; just trying to help each other out.

All of the peers he mentioned are all in top-tier universities all across the country. One of them is an engineering major at a military school. They continue to encourage each other now that they are in college.

### Analysis

These four African American males who chose to participate in this study were complex individuals. The application of attribution theory to analyze the data helped to synthesize the data into manageable chunks while providing me a systematic way of what Weiner (2010) calls the behavioral consequence and what I am using synonymously with Moustakas (1994) essence of a phenomenon. The following analysis was arranged in the flow chart from attribution theory. Each section opened with a brief description of the category followed by excerpts from transcripts that support the category.

### Outcome

The outcome of attribution theory was the phenomenon under investigation. The phenomenon examined in this study was which high school experiences influenced African-American males to pursue science, technology, engineering and mathematics (STEM) degrees. Through purposeful sampling, all participants experienced this outcome.

### Outcome Dependent Affect

All of the informants expressed a sense of happiness of their choice to pursue a STEM degree. Some of those choices were tough because of external pressures. John speaks of his mother wanting him to pursue a pre-medicine degree versus nursing:

My mother will tell me that I should do this or I should do that. She thinks that I should be pre-medicine and she tells me that all the time. I have to explain to her

that is not for me. I've explained it to her about ten times in the past eight or nine months and it is getting to the point where it is aggravating. As a child, you have to respect that's what she wants, but I think that she is accepting the fact that I am in nursing.

John felt "truly happy" when reaching his goals and one of his goals is to obtain a degree in nursing. "Happiness comes from attainment, and you can't get that from anything else other than that", he stated.

Matthew said, "Happiness is something you want personally". He went on to say, "Happiness is what I want and what I'm getting out of life and that includes pursuing a STEM degree". Looking to the future, he wants to make someone else happy by "helping that person to have a better life". Matthew described his feeling of accomplishing goals as "happy" and that happiness stems from words from his faith. He said, "I live up to the prayer of serenity. Lord, grant me the serenity to accept the things I cannot change, the courage to change the things that I can and the wisdom to know the difference".

### Causal Antecedents

A causal antecedent was an event that occurred prior to the outcome. The causal antecedents of the informants were arranged using the pre-college socialization and readiness interval of Harper's (2010) STEM pipeline. Those subcategories are familial factors, K12 forces, and out-of-school college prep experiences.

#### Familial Factors

Luke, Paul, John, and Matthew's family backgrounds were just as diverse as the degrees they are pursuing in college. Luke and John were from two-parent households,

Paul was raised by a single mother, and Matthew was raised by his grandmother and other “mother” figures due to the untimely death of his biological mother and his father not taking an active role in his life. All of them described their relationships with their families as good, and although they may not understand what a STEM degree is, they all took education seriously.

Luke had a very strong relationship with his family. That bond with his family was the primary reason he decided to stay local despite having a GPA and test scores that allowed him to attend school virtually anywhere.

Matthew’s grandmother and soccer mom encouraged him to go to college and pursue a degree that interested him and that later could help him enter into a career that he would enjoy going to everyday. He attributed his relationship with his “mothers” as influencing him to go to college and pursue a STEM degree. He said in his first interview, “Being around them and them knowing me and how much I like things like CSI, they knew I had a passion for it. They suggested that I should go into something like forensic science”. He expounded upon this in his second interview:

My grandmother’s view of education is that it’s required for you to be successful. Having an education will open more doors. Not having an education would have fewer doors to open. You definitely have to graduate from high school. Not everyone is going to college, but they will do things like military. But in either way the education is needed. I feel like without education my choices will be limited. I definitely want to pursue education at all levels.

Paul grew up in a family of educators; they are all proponents of education. His family supported and encouraged him in his pursuit of education. He was extremely

close to his mother. A divorcee, she instilled in him that “no matter what happens or whatever shortcomings that we may go through we will always be there to support each other”. She knew his idiosyncrasies and all of his “little quarks” and had the ability to sense when his is overwhelmed, stressed and not getting enough sleep. She advised him to “come home and relax’ so that he can get away from the atmosphere or the environment that he was in so that he could actually relax. She understood the strain of pursuing a STEM degree at a top-tier liberal arts university and encouraged him to get away from it from time to time. He went on to say:

She has seen my struggles and challenges that I’ve had in college that were not necessarily there in high school. But she is also seeing that out of that I’ve come out of those experiences better than before. My study habits have improved from the time that I first got to college and had my first exam until now. I’ve always seen growth. I’ve been able to mediate the science and the pre-medicine world in courses such as organic chemistry. And then there’s physics which I am in right now that is also a challenge. They’ve always say that no matter what I do it doesn’t matter what grade that I received they understand that high school is high school and now I’m in college and it is much harder. They are there to support me every step of the way. They know that I’m in school working hard. They know that I’m not goofing off. So they understand that this is going to be hard but they also want me to tap into those resources and do what I need to do to pass and keep my scholarship.

He partially attributed his success in pursuing a STEM degree to her constant encouragement when he showed interest early in his life:

My mother has seen me come from just wanting to be a doctor in elementary school after taking a field trip to the CDC to reading *Gifted Hands* by Dr. Carson and wanting to become a neurosurgeon. I even did a career project in the seventh grade where I had to do research on a career and find out about its requirements to achieve this career and factor in a house, car, and family. So I'm thinking about these things at thirteen years old and my mom was there then and now.

Her support for him did not end in elementary and middle grades. He said, "She was also there for me in high school when I was working toward these things and trying to get into a top tier school".

Paul felt that his mom admired his work ethic. When she reflected on her experience in college she admitted to him that she partied too much her first year and it took the remaining three years to repair the damage that was done. He felt that she knew that parting was not really his thing, but there were other potential distracts out there that could derail his success. Although she encouraged him to work hard and do his best, but she understood the need for balance and that he needed an outlet so that he could relax. Some of his outlets were going to concerts, album and magazine release parties.

He admitted there were times where he could become "off kilter or off track". It was at those moments where his mom would ask him if this was what he really wanted to do. She did this as "little checks" to make sure that he is okay. Either way, he felt that she would support any sound decision that he makes.

John also had a supportive family. Different from the others, his parents placed a particular interest in him pursuing a STEM degree; particularly, his father who was a huge support system. His father emphasized the financial benefits of earning a STEM degree.

Although they preferred for him to earn a more traditional STEM degree such a pre-medicine, they still encouraged him to pursue a STEM degree that will ultimately make him happy. He said:

My dad says science, technology, engineering and mathematics is where the money is. While they emphasize that success is not solely based on education, they do not want me to waste my time in college. So they are very supportive of me pursuing a STEM degree. Even if it's not nursing, they want me to do something related to STEM. I can't imagine going home and telling my parents I'm going to major in a non-STEM degree. I just can't!

John had high regard for his father. He mentioned his father more than his mother in all of his interviews. In his second interview he said, "He is poor economically but I would say that he is mentally tough because it takes someone who is mentally tough to realize some of the things that used to work a long time ago that does not work and make adjustments". He described his father as being economically disadvantaged but mentally advantaged. I asked to define mentally advantaged. He said:

Mentally disadvantaged is when you accept your situation and refuse to fight for something different. You may not say that but whenever a person starts to attribute economic disadvantages to others and everyone else is the problem to their situation and does not resist the notion to be complacent with their current situation then you become mentally disadvantaged. People who are mentally disadvantaged will say a thing like the government is not good and that they are not enough jobs available. They follow up those statements with lack of finding and even seeking the few jobs that are available. Whenever you stop trying to get

better and accept the few options that are available to you I believe that is when you are mentally disadvantaged. At that point you're not coming to play. You're not playing to win.

#### K12 Forces

There were several pre-college forces these young men attributed to their pursuit of a STEM degree. Those forces include taking rigorous courses in high school that adequately prepared them for college and inspiring teachers who went beyond the traditional role of a teacher. Luke was glad to take tough classes like Advanced Placement Chemistry in high school because it made college easier. He said, "I felt like this is what I was training for. All of the difficult problems that the teacher made us go over in high school were stepping stones for college".

Luke measured his success by his ability to grasp concepts quickly when in college. He reflects how his experience in high school chemistry connects to the chemistry he is taking in college:

In college I am taking Chemistry 1211K which is similar to Honors Chemistry and I did pretty well in the class. I received a grade of a B with very little effort because everything I learned in Advanced Placement Chemistry was what was in Honors Chemistry in college.

He recalled having to do labs and write lab reports in high school; many of which were repeated in college. "The experiments that we did in college correspond to about four experiments that we did in high school", he said.

Luke experienced a lot of success in college calculus based on his exposure to calculus concepts in high school:

The stuff that I learned in high school we are kind of reviewing it now in college. So whatever my professor is teaching in college, I have already seen it once before. The intricacy in college is a little different where we have to go into details about the little things. You talk about concepts on a broader level in high school whereas it goes more in depth in college.

Luke spoke of how model building was a major teaching technique in his science and mathematics classes in high school. “Our end-of-the-year projects were always revolving around models”, he recalled about his Advanced Placement Calculus course that he took his senior year. The teacher would require them to make “3-D models in order to give a visual representation of the concepts learned”.

Luke went on to speak about the theme and program of study of the magnet high school he attended. “My academy definitely prepared me for college”, he said. He remarked:

Because STEM was ingrained in my head throughout high school, because I was in the math and science program, and since I’m learning all of these different concepts of math and science that perhaps I should go to college and major in a STEM major like Biology. I really felt that this is what they were training me to do.

Paul shared his experience in his Advanced Placement Chemistry class. He stated that this was his first exposure to college level work. In the end, he was able to score a three on the Advanced Placement Chemistry exam. Although that was not a passing score for advanced placement exams, a score of three or higher was generally accepted by most colleges and university for receiving college credit for the course.

He also credited his Advanced Placement United States History class as a source that helped him to prepare for STEM degree in college. This was interesting as he admitted that social science was his least favorite subject among the four core subjects that would include science, mathematics and English. This particular class forced him to conduct a lot of outside research in order to be adequately prepared for class discussions and exams. Along with the requirement of research, this class also taught Paul how to look at things thematically. He spoke about how he would have to connect past events to current issues in different parts of the world. He said, “As a STEM major, I have to conduct research on past techniques and outcomes and figure out ways to improve them or develop new ones”.

Sound study habits were a necessity for success in challenging courses such as this. Paul said, “I think organization is a good way of working a lot of issues like keeping up with assignments and then setting aside time to study each day, whereas marathon study is always a detriment in terms of an advanced placement course or any college-level course”.

Other forces included inspiring teachers. Luke thanked his Advanced Placement Chemistry teacher for challenging him to “tackle difficult tasks”. She taught him that if he could do the hard task, then he could do anything.

Paul could not readily identify his favorite teacher because there were so many. The common characteristic among all of those he considered were that they “challenged him academically”. I asked him to speak on as many as he felt comfortable. He credited two teachers who challenged him the most as people who positively influence him to pursue a STEM degree; his Advanced Placement Chemistry and Advanced Placement

United States History teachers. “My Advanced Placement Chemistry teacher taught me to do whatever it took to do well on the AP exam”. Paul was one of two sophomores in the Advanced Placement Chemistry class as they both took a full year of chemistry during the summer following their freshman year. The program was a seven week residential program that was a partnership between the school district and a local Historically Black College and University.

He always took time to speak to his Advanced Placement Chemistry teacher anytime he was on campus. She would tell him how proud she was of him and offered him words of encouragement to endure the stress of going to a top tier university. Paul respected her advice as he felt she could empathize with his plight as she had children who matriculated through similar universities throughout the country.

Paul shared with me his opinion of the importance of exposure to rigorous STEM courses early during a student’s high school career. He said:

Even though I am not majoring in chemistry, I feel like she was there as an early influence or high school influence to pursue a STEM major. It’s all about inquiry and looking up stuff on Google or YouTube and trying to learn how to do different things. Science is one of those avenues that allow you to explore questions and forces you to design some sort of experimental set up to find the answer. It’s systematic, but it also allows you to use a little intuition in trying to find out answers to life’s many problems.

The other teacher he mentioned as influencing him was his Advanced Placement United States History teacher. He described their relationship in the following manner:

In addition to him being a wonderful teacher, I thought that he was a positive role model. I looked up to him for advice and getting ready for college. We would have conversations from everything from family to school to relationships. I felt that I could confide in him. I feel that he is someone that helped me in my growth in high school and as a man.

He said, “He always felt just one trip or phone call away from the school to connect to these individuals and everything would be okay”.

In his second interview, Paul went on to say:

At each level from ninth grade until now every challenge that I faced has helped me in terms of sensitizing me to the next challenge. I would know that since I got one thing that when I encountered another problem I would have confidence to get through either by using the same techniques or making adjustments. I thank all of my teachers for that because college has been a lot about facing challenges in dealing with different obstacles that you may have in a particular class.

Matthew recalled how his homeroom teacher took a special interest in him despite him never taking her class

If she saw me in the hallway she would make sure that I’m doing my job, where I was supposed to be, or check to see if I needed any help with anything. I knew that I could come to her if I needed to talk. She was a role model. She was an administrator figure if an administrator was not around.

When speaking specifically about content, he recalls how taking a forensic science class in high school helped to prepare him to major in forensic science in college,

“My teacher basically broke down everything about forensic science”, he stated. He goes on to say:

The forensic science class I took in high school was actually one of the classes that I took during my freshman year of college which was Introduction to Forensic Science. Everything that my high school teacher taught us throughout the entire year I learned in one semester in college. When I took tests and went over things in class, I already knew it. When my professor would ask me do I know the answer to a certain question I could always respond with a yes because I already learned it in high school and I still had my notes.

He also credited taking Advanced Placement Calculus AB in high school for preparing him for his Introductory Calculus class in college:

It was during the first week of class that I realized that I just learned the material in high school. When we were going over things in my college course, I can still remember things from high school. Even if it wasn't clear at the time, as we went over the material it became clear to me.

He speaks about the advantage of seeing the same material twice:

Even when you don't understand it the first time [in high school] you have a better understanding of it when you see it the second time [in college]. Even some of the things that I didn't fully understand in chemistry while I was in high school I got a better understanding of it once I saw it the second time in college. It became very clear the second time that I saw the material.

John, Luke and Paul echoed Matthew's sentiments regarding the benefits of seeing a course in high school and again in college. John took Chemistry and Advanced

Placement Chemistry in high school. He only earned a two on the associated Advanced Placement exam; however, the exposure to the content in high school helped to prepare him for success in college:

My teacher in high school taught me to approach technical science course like mathematics courses. You study math by constantly doing problems. Practice problem after practice problem after practice problem. The more you do the practice problems the more usually remove any flaws that you have; flaws in judgment. I can't do that again. And once you master that, you can focus on application. It really comes in handy in college because in college, I had to take chemistry, but I easily made a perfect score on every single exam because I developed skills in high school that enabled me to bypass my peers and I would not have gotten that otherwise.

Moreover, John appreciated this high quality education was in his local public high school and he did not have to go to the "other side of town". He said, "I really appreciate how the door was open for me to do anything that I wanted to do. Everything was in my backyard".

Luke took Advanced Placement Calculus in high school, but did not take the Advanced Placement Calculus exam. Regardless, he felt that his college level class was moving "slower" than his high school class.

Like John, Paul appreciated the variety of rigorous STEM classes offered in his high school.

My peers and I were excited to take the science pathway in my academy where we were able to take microbiology and genetics. Those are courses that many

schools didn't even offer; especially not public high school. I know that there are offered in college now. The fact that we were exposed to those things early on was beneficial.

Paul said his exposure to rigorous high school courses got him through the first year of college. He said, "After freshman year it was all new so we had to think of different ways to think critically".

Paul earned a three on the Advanced Placement Chemistry exam, but still had to take an introductory chemistry class due to his college's requirement of receiving a five on the exam to receive college credit. Despite this, he reflected on his experience in Advanced Placement Chemistry and how it played a role in his success in college:

That was the first time that I was fully submerged into college-level rigor and college-level work. That was a class that I really appreciate once I got to college when taking General Chemistry I and II and even Organic Chemistry. Organic Chemistry is the mother of them all. If it was not for taking Advanced Placement Chemistry in high school, there is no way I would have been as successful in college".

He went on to say, "Everything that we did during the school year was in preparation for the exam and ultimately college. This was my first introduction into advanced placement classes and it was a good way for me to get a taste as to what college would be like".

#### Out-of-School College Prep Experiences

Participants in this study participated in a wide range of extracurricular activities including the band, clubs and sports. They were involved in out-of-school college prep experiences such as summer programs, Chess Club, Beta Club and Chemistry Club.

Luke was a member of the Beta Club, Chemistry Club as well as a two-sport star athlete earning MVP awards in swimming and baseball. When considering those activities that propelled him to major in a STEM degree, those activities included the Chemistry Club and Chemistry Olympiad. Luke recalled the chemistry club, “It opened my eyes to my love for science”.

Additionally, he participated in a Chemistry Olympiad on Saturday mornings. Benefits of his participation in the program not only benefited him in his high school chemistry course, but it introduced him to basic organic chemistry concepts. Additionally, they worked on released test items from the American Chemistry Society. Once in college, he saw many of the same types of questions. He recalls, “When I got to college, I took the same type of tests that were given to me at the Science Olympiad”.

Matthew was also a member of the Chemistry Club. He attributed his participation in the club to his ability to major in a STEM degree:

When people hear about chemistry they think that it’s hard because of all the formulas and stuff, but if you learn the basics before getting into the complexity of the subject then you start to find things that you like about it. I found that I like it more and more and it made me want to hold my ground in majoring in forensic science.

John was also a member of the chemistry club. He credited the chemistry club with giving him the opportunity to conduct real scientific research at a college. Additionally, he participated in the chess club. The chess club added a competitive dimension in his life. He now views everything as a competition: graduate school

admission, scholarships, jobs, etc. He said, “Nursing is where the jobs are now. A lot of people want to get into nursing. It is a completion to get the best job”.

John also participated in two STEM based summer internships; both spanned the entire summer in a college setting conducting research with a professor. The internships required him to not only conduct research, but justify his findings through weekly oral and written presentations. He credited his participation for giving him the courage to take “challenging or accelerated courses”. He says:

I participated in two internships. They were both with the same institution. It was a research internship that’s really nationwide. The whole idea is to give high school students motivation to pursue research because the nation needs more students interested in STEM. I participated both years. The first year was the easiest year to get in because they were trying to just spread the net and see who bites. The second year, they choose from the group that attended the program the first year. They asked themselves who were the interns that were most promising and that were most successful and who would really commit to it for another year. That’s how I was chose the second year. It made me feel good. Because of that I’ve had opportunities to do more now that I’m out of high school because I network the entire time.

He described his experience in the internships:

You would do STEM related research. You would attach yourself to a research group and learn about their project as much as possible. You would make as big as a contribution as you can on the project while developing your own take on the project as well. That is a real challenge because I have to take something that I

have not fully mastered, of course no one really has because it is research. I have to take something like that and build enough knowledge about it in a short period time to be able to present this college professors research who has written hundreds of research papers and now I have to as a high school student explain his research to another person. I have to explain why his research his important. A lot of times you have to figure out why it's important yourself. A lot of times if it's pure it does not have immediate applications. You have to try to explain that. Then you have to take it back and explain it to everyone else. That really has helped me now. Every week in the program we had a research of about five or six interns; all high school age. I was the oldest both years. So when I was a junior everyone else was either a sophomore freshman. The second year I was the only intern from the first year to be invited back. So that was one out of seven that actually came back to the two spend a second year. So no I have younger interns looking up to me. They would say things like he has done it two years. It must be a pretty good program. Every group meeting you're sitting there with a group of professors and they may be of different departments. You have organic chemistry professor, a lecturer, a professor with varying degrees of knowledge in the same room. It was so intense. You would have a high school student all the way up to someone who has 30 or 40 years of research who has written hundreds of papers and well known throughout the country. Here I am, just a high school student, at the same table. I had to present at the end of my second summer internship a chemistry project in front of the board of college professors. My mentor, or the main researcher whose work I was explaining, walked in late

because he has so much other stuff that he had to do. But when he came in, I was explaining is project. I did such a good job at it. Even while being bombarded by the organic professor. He was constantly bombarding. But that's his job. That way when people outside of the program question me, I'll be ready. Not to say that I argued him down, but I did; in a respectful and professional setting of course. He felt very proud of me because he watched me over two summers and develop the skills and techniques needed to defend something that may not have been exactly easy to learn so well in a short period of time.

Seemingly unrelated, Paul credited his participation in the band as an experience that prepared him for success in pursuing a STEM degree:

A lot that people don't realize about being a STEM major is that you have to have interpersonal skills. In this research, how I interact with my principal investigator to ensure their expectations are met as well as my own expectations and that I am not conceding things that I am passionate about. A lot of these organizations and things I was involved in while in high school they involve me being able to relate to other people and communicate effectively. That is one thing that they really drive with STEM fields. I know my ideas. I have to make sure that my professor or my instructor understands my ideas. Going through each step clearly and with enough brevity is important for them to understand that this is what I did. A lot of the positions involve me communicating and ensuring that I knew how to interact with people in a positive light. That may mean emailing people for recommendations, emailing people to work in their labs or shadow them is

something that I feel that each and every leadership position and extracurricular activity that I've done in high school effectively prepared me for.

It was at these outside of school educative experiences where they express an awareness of their race, but also articulated a confidence to be successful despite stereotypes of African-American male's deficiencies. John faced these perceived inadequacies at a science fair competition. He was tempted to stay with his peers, but was courageous to overcome his subtle fears and spoke to students of other races. One of these conversations resulted in the offer to attend the very summer internship mentioned earlier.

Luke faced the issue of race at the Science Olympiad. Luke's school district was majority African-Americans. The Science Olympiad was comprised of schools from surrounding areas whose demographics were not congruent to his. When he would proudly say that he is from the "top school" in his district they would reply it would be the "lowest school" in their district. Despite the racial intimidation, his confidence in himself and prior preparation never wavered. He recalled first walking into the completion and viewing the crowd, "I didn't believe that they were any smarter than I was or more capable than I was".

During John's summer internship, he had to present in front of several professors and his peers to explain his end of summer project. During his defense explained that he was "bombarded" with tough questions from the organic chemistry professor, but at the end, he felt that he successfully did so. It gave him a sense of pride that he, as an African-American male, was able to explain his project in front of older Caucasian professors with years of experience. John recalled, "I feel like I'm helping to contribute

to a better future for all young African-American men so that all young African-American men can have opportunities that I had or at least all can be given a chance to get it". In preparation for the presentation, he remembered working with students from other ethnicity and nationalities and saying to himself: "Forget that I'm African-American. That does not matter. All that matters is that I can contribute to the research".

Although time consuming, my informants never found their participation in out-of-school experiences as burdensome. Paul was involved in a summer program every year since elementary school; most focusing on STEM. One program was a six-week program that awarded him a full credit in chemistry. That was what allowed him to take Advanced Placement Chemistry as a sophomore. Additionally, he participated in a three week residential STEM program at the vary college he is currently enrolled and pursuing a STEM degree.

Paul was also a member of a male imitative group that was sponsored by his Advanced Placement United States History teacher. He described the group as "a way for junior and senior males to make sure that we build a bond and build a connection with ourselves". The members of the group were friends prior to the formation, but the group was an interesting way of building a sense of brotherhood about men supporting each other.

#### Causal Ascriptions

Overwhelmingly, informants in this study credited their effort and prior preparation over things such as luck for their pursuit of a STEM degree. As mentioned earlier, a lot of their prior preparation came from the high school they attended.

Additionally, they ascribe to hard-work, diligence, and perseverance. John said, “I don’t believe in luck. I believe you make your own luck through prior preparation”.

### Causal Dimensions and Psychological Consequences

The three causal dimensions were locus, stability, and controllability. As defined earlier in chapter one, locus is either internal or external, stability is the expected length of time the cause will act upon the subject, and controllability is the degree the subject has to affect the outcome.

#### Locus

Informants unanimously ascribed their achievement to effort and prior preparation; therefore, the locus is internal. This corresponds to Weiner (2010) stated that internal factor had a greater influence on achievement than external factors.

#### Stability

Stability is the expected length of time the cause will act upon the subject. Because the act of effort is internal, the expected length of time is indefinite and thus, stable. This level of stability was influenced; however, by some external factors. As mentioned earlier familial factors, K12 factors and out-of-school college preparation experiences all played a role in supporting these four African-American males pursuit of STEM degrees. Additionally, they found support from mentors.

Paul sees his high school history teacher, who also was the sponsor of a male initiative in which he was a member, as mentor. Even though his background was not STEM related, the teacher supported Paul’s decision to pursue a STEM degree. “He understands the importance of having an understanding in science, technology,

engineering and mathematics”, he recalled. He went on to say, “He would support whatever decision or whatever goals that I had.

Matthew described his home environment as “the hood”. Matthew’s mentor was his soccer dad and he credits him “staying out of the streets” and not becoming a victim of his environment. Other than his soccer mom, Matthew did not have any other people he specifically mentioned as a mentor. “Those individuals probably don’t know they were my mentors”, he said. He chose to admire certain characteristics of people from afar:

I’m not the type of guy that would attach myself to people often. I don’t really attach myself, I just sit in the corner and see how they handle different things. Or I’ll read about how they handle different things if they are celebrities. I’ll try to be the same way. Try to take on those characteristics. One person may not overall be my mentor, but how they handled themselves in certain situations makes their attributes a mentor.

His mentors did, however, share common view of education. “They all view education as important”, he said.

Similar to Matthew, John never explicitly sought out a mentor; instead, he paid special attention to people he referred to as “quiet mentors”. Those are people he didn’t know they were mentoring him. His freshman science teacher was a “quiet mentor”. He transferred schools after the first two weeks because the course was too challenging for him. He later returned to the school, but did not take that particular class. John was able to learn life lessons from this situation despite not completing the course with this particular teacher. He said:

He revealed something about myself that I did not like. Now I try my best to change that. I don't want to ever be that same cold feet freshman that runs from a challenge. Mainly what I appreciate about the teacher is he's going to make sure that he provides the best that he can and he's not going to hold any punches back just because you're thirteen or fourteen years old. He's not going to hold any punches because it's a different generation. He's going to do exactly what he's been doing for the last thirty years that has proven to be successful and I think it's probably one of his personal goals. Those personal things that he feels makes people successful. I'm pretty sure he does not measure success based purely off of passing an End-of-Course Test or any other standardized exam. He measures success differently and he makes sure that he instills that into every freshman that he teaches. Whether it's a magnet student or when he taught students outside of the magnet program, he held to his integrity and his values. Because he did, I am sure that those students benefited as well. Even though I did not take him my full freshman year, I know that I benefitted from taking him the time that I did. I know all of my peers that took him benefited as well. When I contact my peers they tell me about college and how easy it is and how everyone else is struggling. And it is mainly because of this teacher. I really appreciate that.

Another silent mentor was his principal. One of his principal's quotes he lived by is, "To be successful you have to remember three things: get up, dress up, and show up". He went on to say how this quote is applicable in his life today:

This quote is really helpful in college. Every day is different. I have one class that is at 7 a. m. in the morning. I use public transportation because of certain

circumstances. So to travel across town you have to wake up at a certain time. Every day I wake up at 5 a. m. even when I don't feel like it. I remember get up, dress up, show up. You can't get anything done if you're not there. It has built in me a good foundation for resilience.

All of Luke's mentors had a positive view of education. He said that they felt that "education is vital". He said:

You definitely need enough of it. It also depends on what career you are in. They all view education as important. They are all at the top or near the top of where they're supposed to be as far as education. So, if it is more skilled based, then they have more skills. If it is more academics, then they are up there or trying to be up there as far as education goes. They are very ambitious in terms of education

Most of them were in STEM related fields, so "they appreciate STEM and its contributions to society.

#### Controllability

Luke, John, Paul, and Matthew all expressed a high degree of control on their outcome of pursuing a STEM degree. This was express through their attribution of choice over force to participate in various programs; some of which were mentioned earlier. All of them chose to participate in things like the chemistry club, chess club, and summer enrichment program; all of which propelled them to go on and pursue a STEM degree. Luke felt that "there was no other option". "If I have a passion for something, then I'm going to choose to do it and do it better than anyone else", said Matthew. John said,

“You always have a choice. You can choose not to prepare or not to prepare as well as you should, but you will suffer the consequences of not being as successful”.

### Behavioral Consequences

Behavioral consequence was the final phase of attribution theory. I attest it was at this part that the theoretical framework and the methodology met. In other words, the behavioral consequence from the four African American males in this study was the essence of the phenomenon. Through the analysis of the data from the four participants, it has been revealed that self-confidence is the essence or behavioral consequence of African American males who pursue STEM degrees as undergraduates.

Litzler, Samuelson and Lorah (2014) defined self-confidence as “individual’s general belief that he or she has the ability to produce results, accomplish goals, or perform tasks competently and perceptions of self-confidence and vary by domain” (p. 3-4). This was aligned with finding using a phenomenological case study methodology where the essence can be found outside of the domain being examined.

John demonstrated his self-confidence several times throughout his high school career and so far as an undergraduate. As a high school student he participated in the district science fair. While there, he interacted with students from other schools who looked different from him. He spoke about how other students from his school would only speak to other African-American students. He, however, was confident enough to share his research with students from other high schools whose demographics were significantly different from his.

At first when we got there, there was a temptation to be with people who look like you. But I said that I cannot do this. There were students from other high schools

on the other side that have interesting projects. I think I led the way for our school to go and talk to these other student. First, I walked up and I shook his hand. Then I talked to him about his project and I discussed mine. I talked to him some more and he told me that his father was a chemistry professor at a major college in the downtown area.

His ability to be confident in himself and his research led to other opportunities while in college.

As an undergraduate, he spoke about his ability to balance his personal goals with the expectations of his mentors. Some of his choices where not favorable to his mentors, but he was confident that his choice was the best for him at that time. One particular instance was the choice to participate in an internship or to take additional courses during the summer following his freshman year:

This summer I had the option of a number of summer internships; full research in chemistry. I like chemistry and I like the research and it builds my resume as far as previous summer job experience. It is needed, but at the same time I have to evaluate that in light of my other goals where I see myself short term. For me, that is the next three years. I need thirty credits to be a sophomore student in college. At this point I only had twenty-one credits. I had already registered for nine summer credits so that I can go ahead and finish up my freshman year. Then I get a call that there is an offer for a summer internship and I can't do both. One will put a little money in my pocket and will give me some job experience, but the other will ensure that I have all the credits that I need to apply to nursing school. I had to weigh my two options. Either I can get the money or I can get the college

credit. At this point I know that I am not going to do research for a career, at least not chemistry research. My educational opportunity outweighed this one. So I had to call and turn him down.

John went on to explain how contacting the professor who offered him this particular internship was sign of confidence on his part:

That was difficult calling this professor because I wanted to say it in person and tell him that I really appreciate him offering this opportunity. When I first called him I got his voicemail. After I got the voicemail I thought that he was probably busy so I decided to send him an email. I had to sit down and outline exactly what I needed to say to not only show gratitude for not only offering me the position for the second year in a row, I had to explain why I had to turn it down. I also encouraged him to continue to offer students the opportunity. I know that if I were in his shoes then I would feel a little discouraged that there is this student out there that does so well in chemistry but he want to go another direction. First of all he wants to go into nursing and second of all I offered him this opportunity twice and he has turned me down both times. The first time he turned me down for another lab and the second time he turned me down was for courses. I had to outline that and send it to him. That really required some growth on my part. My first thought was the boy thought. If it's not an opportunity that you want to take advantage of the duck and not call him back. Just don't show up. I think that showed some element of holistic success because writing down an outline and emailing him an explanation as to why that I could not do it. After that I talked

about it with my family. I realized that he is successful and that he probably had to turn down opportunities himself.

Paul spoke about how his self-confidence allows him to be successful pursuing a STEM degree at a top-tier, private, and prestigious university:

There have been a lot of ups and downs. My school has been a challenge for me not just because it is a top twenty university which with that title and prestige are expected to be a challenge. I've learned a lot about myself in college that I did not know in high school. It has been good overall. When I think of all the courses that I've taken and the different experiences that I've had it has led me to growth to understand more about myself in terms of my limit and what things work well for me and what things did not work well for me; particularly my STEM courses. It's really a test to how diligent I am and how I really don't get deterred in terms of looking at my exam scores and realizing that this did not work the way that I wanted it to so how can I adjust? It's all been about adjustment in finding out what I am interested in and do things that will ultimately get me to my future goals which are medical school and going into something that I would be willing to do for the rest of my life.

Matthew demonstrated self-confidence when he challenged himself to take Advanced Placement Chemistry when none of his friends would dare to challenge them in that manner. He said:

When people talk about chemistry, they think that it's hard because of all the formulas and stuff. I am not scared. I am confident that if you learn the basic aspects of anything prior to the complex concepts, you will start to find aspect of the content

that you like. I found that I like it more and more. It made me want to hold my ground and major in forensic science.

Luke's positive expression of self-confidence was exhibited at a competition with students who were of different ethnicities than him. It was during the Science Olympiad competition that his self-confidence was on display. He noticed the difference in the ethnic make-up of his school and that of the other schools the moment he entered into the room. I asked if he felt intimidated by their mere presence. He replied, "No! I didn't believe that they were any smarter than me. I actually felt that I was more capable than them".

Luke's case of self-confidence was different from the other three participants in the study. The other three African American males combined their self-confidence with the willingness to work hard. Luke, however, paired his self-confidence with a minimalistic mentality. The result was overconfidence. This was evident when he received the results from his Advanced Placement Chemistry exam. He said, "I felt that he knew the material better than anyone else, but prepared the least". He even provided of percentage of how much relied on his natural talent versus his preparation: 70% to 30%.

His overconfidence came back to haunt him in college as well. He was satisfied with making a C in his history class because that grade required little effort on his part and that was the minimum grade needed for him to satisfy requirement on his program of study. Despite a grade of a C in the class, he was confident that he could score a B on the final paper and that should be enough for him to pass the class. He said:

I was supposed to make a C out of the class. Then I wrote the final a paper an all I needed to maintain my C was to score an 80% or higher on the paper. I spent a lot of time writing that paper and then I received a grade of zero on it because he said that I had one line that was plagiarized. So he gave me a zero. So instead of receiving a grade in the mid-70's I received a grade in the mid-60's. Now I have to take the class again in the fall.

### Summary

A premise at the onset of this study that the unique paring of theoretical framework, attribution theory, and methodology, phenomenological case study, would fill in the gap of literature as to what contributes African American males to graduate from high school and pursue a degree in science, technology, engineering, and mathematics (STEM). At the time of this study, no other study existed that connects self-confidence of African American males and their desire to pursue a STEM degree as undergraduates.

This chapter opened with the stories of four African American males high school experience who are currently pursuing a science, technology, engineering, and mathematics degree in as undergraduates. Their stories included a wide range of topics that included their home environment, religion, and definitions of manhood. Attribution theory was applied to their stories as a way to systematically analyze the data and arrive at the essences of the phenomenon being studied.

Attribution theory allowed me to explore several possible attributes that contributed these individuals to pursue STEM degrees. Those possibilities included familial factors, mentors, and out-of-school experiences. All of these possibilities were

found in existing literature regarding African-American males who proceed to major in STEM degrees following high school (Harper, 2012). In true phenomenological fashion, it was not these “seen” attributes that were found to be the essence of the phenomenology; rather, self-confidence was the essence that emerged from the analysis of their stories (Moustakous, 1994). Griffin (2007) found the high-achieving African American often draw on internal sources such as self-confidence to succeed. The following chapter will contain a review of literature pertaining to the self-confidence of African Americans in college.

## CHAPTER 5

### LITERARY REVIEW: PART II

The previous chapter included the stories of four African American males who are currently pursuing a degree in science, technology, engineering and mathematics (STEM) as undergraduates. Analysis of their stories using attribution theory revealed the essence of this phenomenon: self-confidence. Phenomenological case study is the methodology employed in this study. As such, an initial literature was conducted in chapter 2. That initial literature review was inclusive of the four types of literature reviews conducted in phenomenological studies: integrative, theoretical, methodological, and thematic. Seven studies were examined because of their diversity in the use of theoretical frameworks, diversity in the use of methodology, and current. Phenomenology required a second literature review of the essence once it has been revealed (Moustakas (1994).

Moustakas (1994) stated the purpose of the second literature review is to distinguish the findings between this current study and with the findings of the existing studies. This second literature review looked at multiple current studies addressing self-confidence of individuals and various aspects of STEM in their lives. Similar to the initial literature review, close attention is paid to each theoretical framework (if available), methodology, and themes that emerged. These studies examined multiple factors such as gender and ethnicity. For the succinctness to the focus of this study, I exclude any results from these studies that are not pertaining to African American males. The literature review concludes with a comparison of the articles among each other and between the findings of this study.

### Summary of Current Studies

Moakler Jr. and Kim (2012) stated their purpose for conducting this study is to fill in the literary gap that exist between female and minority student's confidence in mathematics and academic abilities and how the presence or absence of said confidence can affect their choice to pursue a major in science, technology, engineering, and mathematics (STEM). The study sought to do this by answering three research questions: 1) how does a background factor such as gender, minority status, parental socioeconomic status (SES), parents with STEM occupations, and academic preparation affect a STEM major choice, 2) how does academic confidence affect a STEM major choice and 3) how does mathematics confidence affect a STEM major choice.

The authors of this study chose to use the Social Cognitive Career Choice Model (SCCCM) as a methodology to analyze their data and answer their three research questions. Their justification for using this model was that "it is commonly used in career development and STEM-related studies" (p. 131). They indicated most research that uses this methodology focus on STEM career choice, STEM degree persistence and graduation, and STEM employment.

Personal experiences and background, learning experiences, self-efficacy, and outcome expectation were all described within this methodology. Social Cognitive Career Choice Model stated that personal experiences consisted of gender and racial minority status and background contextual affordances consist of preparation for college and their parent's social economic status consisting of three variables: parental income (measured on a 14-point scale), parent education (measured on a 8-point scale), and parental STEM occupation (measure on a dichotomous scale). The researchers used

participants SAT score (verbal and math only), high school GPA (8-point scale with plus and minus), and hours spent studying per week studying (8-point scale) to measure academic preparation for college. The parental social economic status was calculated using their income, education, and STEM occupation. Self-efficacy was measured using mathematics and academic confidence through self-reporting on a five point scale with five rating where five indicated their confidence is in the highest 10% to one that indicated their confidence is in the lowest 10%. Ultimately, STEM major choice was the outcome of all of the participants in this study through purposeful sampling.

Data was collected from 2003 first-time, full-time, U. S. citizen students in 4 year colleges and universities. Authors defined minorities as African American and Latinos. Fifty-seven percent of minorities in the study indicated they were academically confident; however, only 34.5% indicated they were mathematically confident. They also found that academic confidence, mathematics confidence, parental STEM occupation, high school GPA, weekly hours spent studying, SAT score and minority status were are significant positive predictors of choosing a STEM major. They found students whose parents' occupations were related to STEM where 1.6 times more likely, students with an A and A+ GPA were 3.9 times more likely, students who did more than twenty hours per week were 1.6 times more likely, students whose composite SAT score greater than 1500 was 20 times more likely, and most surprising was that minorities were 1.4 times more likely.

The previous statistics were considered the base model. Academic and mathematics confidence was added independently to help determine if either impacted the results. When academic confidence were added to those variable; all likelihoods

decreased; however, the following still indicated significant positive effect on students pursuing STEM majors: high school GPA and minority status remained high. As mathematics confidence was added to the base model the following show positive effect on students pursuing STEM majors: parental STEM occupation, parental education, high school GPA, and minority status. Mathematics confidence significantly increased the likelihood of the aforementioned variables.

Litzler, Samuelson, and Lorah (2014) sought out to fill in the gap in the literature regarding self-confidence in undergraduates majoring in engineering. Using social-cognitive theory, they examine data from the Project to Assess Climate in Engineering (PACE). They found that this data set was most desirable because of the large number of participants across multiple schools. PACE is an online survey and the authors used data from surveys administered in 2008. The survey included over 10,000 respondents from over 350 schools. Both numbers were reduced in an effort to focus on the targeted group of the study. The final count after reduction was 21 schools and 7,833 students participating in the study.

Analysis of the data sought to answer two research questions: 1) how student STEM confidence levels vary by racial/ethnic group and gender and 2) how STEM confidence is affected by personal, environmental and behavior factors. They define personal factors as perceptions and desirability of the engineering field. Environmental factors included perceptions of professors and comparison and interactions with other students. Finally, they define behavioral factors as their GPA.

Results from this study indicated that minorities majoring in engineering have lower self-confidence than their White counterparts; however, when variables such as

personal, environmental and behavior factors are controlled, they actually show higher confidence than their White counterparts. Additionally, student's view of professors, comparison to peers, perceptions of the field as rewarding and desirable are positively associated with their confidence whereas indicators such as if they were the first in their family to attend college, had exposure to engineering concepts prior to college, or received needs based scholarships showed no impact.

#### Comparison to other Studies

One surprising result Moakler Jr. and Kim (2012) and Litzler, Samuelson, and Lorah (2014) found was that being a minority was a positive indicator of students pursuing a STEM degree. Instead of embracing this as a positive, the authors attempted to explain the finding using a negative tone. Moakler Jr. and Kim (2012) indicated that minorities who enter 4-year colleges and universities are not representative of the entire population of African Americans. Also, they said that the limit of this study only indicated if they were able to enter into college to pursue a STEM major and not if they had the tenacity to complete the program of students.

Litzler, Samuelson, and Lorah (2014) also found that African American men demonstrated higher levels of self-confidence than their White counterparts. Not as overtly as Moakler Jr. and Kim (2012), these authors also provided an explanation that does not highlight the strengths of the individuals, but rather suggest that these individuals were exceptions and that overall White men generally had higher confidence than African American men. While some negative statistics regarding African American males were presented in this study, they were only presented in an effort to draw comparison. The overarching tone of this study was positive in nature.

In both of the articles reviewed, the authors entered into the studies to examine specific variables. Their conclusions either confirmed or rejected the variables as being able to predict if students' confidence was able to pursue a STEM major. In other words, the results were limited to the domain of variables introduced by the author. Also, the participants were not allowed to tell their story outside of completing a survey. By using phenomenology case study, this study was able to discover a more global result that resided outside of initial variables through prolonged multiple interviews with participants.

Two major distinctions between the two studies included in this literature review and findings from this study were how they defined minorities and how they associated their definition of minority to gender. In both studies, minorities were defined as African American and Latino; their results rarely distinguished the broad term to specific ethnicities. Furthermore, they never associated a single ethnic group to a gender; such as African American males. This study was focused through the use of purposeful sample to report findings regarding African American males.

## CHAPTER 6

### DISCUSSION

This chapter summarized this study around the research question: How do undergraduate African American males who are pursuing STEM degrees describe their experiences in secondary mathematics? In addition, this chapter included attribution interventions to increase the number of African American males pursuing STEM degrees as undergraduates. This was important because of the economic advantages associated with STEM careers. The chapter concluded with limitations to the study and possible future research considerations African American males in STEM.

#### Summary

The study began with the assumption that a unique pairing of theory and methodology will spawn exceptional findings as to what four African American males ascribe as causes for them to pursue a STEM degree. Phenomenological case study was used to allow the voices of the participants to be heard and attribution theory was used as a framework for analysis of their stories. While other studies have examined the topic of African American males in STEM before (Berry, 2005; Berry, Thunder, & McClain, 2011; Harper, 2007, 2010; Harper & Griffin, 2010), this combination of theory and methodology was the first of its kind.

The method this study used was interviews; specifically, several semi-structured interviews where I entered into the interview with specific questions, but had the flexibility to veer into multiple directions in an effort to gain a deep understanding of the participants' lived experiences. The first interview followed the same protocol for all participants. The data from the first interview were independently coded two times. The

first coding was to highlight the participant's life stories so that I could get a better understanding of who they are as a person while at the same time allowing the participants to tell their story. In all cases their stories were rich and unique. The theoretical framework associated with this study, attribution theory, was applied in the second coding.

After attribution theory was applied to the interview, data was coded and categorized into applicable sections of the theory. From there, unique questions were developed for each participant in their second interview. Those questions were derived to fill in any gaps from the framework. These distinctive questions were sequenced in a way that is consistent with the one-direction flow of attribution theory. The sequence of double coding and creation of questions was repeated until there was a common behavior consequence among all the participants.

I attested that this study's methodology and theoretical framework intersected at the essence of a phenomenon and the behavior consequence. After several interview and coding cycles, self-confidence emerged as the common behavior consequence; thus, the essence of the phenomenon of African American males who pursue STEM degrees.

A review of the literature revealed there was not a great amount of studies whose focus is African American male's confidence in pursuing STEM degrees. Two studies were summarized and their results were interesting. Both studies found that when traditional negative barriers for African American men such as poverty are controlled, African American men actually demonstrated higher self-confidence than their White counterparts.

## Implications

Attribution interventions are derived from what participants who experienced a common phenomenon attribute to their success (Weiner, 2000). Coding from the interview revealed several interesting trends that ultimately were not the essence of the phenomenon, but deserved to be mentioned as all of them are aligned in some way to the existing body of literature of African American males in STEM. Those sub-themes are the roles of parents, mentors, early academic experiences in STEM, the pursuit of happiness, financial aid, college preparatory activities, the role of influential teachers, science, technology, engineering, and mathematics themed secondary schools, and religion.

A phenomenological case study can sometimes reveal multiple essences, but these essences must arise from all of the participants. In the case of the sub-theme religion, all but one participant spoke in-depth about religion; thus, it cannot be considered to be an essence. The heavy presence of religion in the majority of the participants directed me to devote a portion of this chapter towards how religion influences African Americans and African American males.

Literature regarding how religion affected African American male's pursuit of STEM degrees is limited (McCray, Grant, Beachum, 2010; Jett, 2010; Toldson & Anderson, 2010; Dancy, 2010). In fact, *The Journal of Negro Education* dedicated an entire issue to highlight the role of spirituality, religion and church on the educational outcomes of African Americans. The following is a summary of several articles from that issue that focused on African Americans and African American males.

Dancy (2010) recognized the meaning of spirituality and religion were complex and synthesized several interpretations to create a working definitions for his study that included 24 African American males across 12 different college campuses. He sees "... spirituality as a worldview in which individuals hold a more comprehensive understanding of self and hold belief in a larger reality than what is experienced in the natural world" (p. 416). He defines religion as, "external activities of belief and worship" (p. 417).

Using a mix of several qualitative methodologies that included grounded theory, phenomenology, and case study, the author unearthed three common themes from participants regarding how their spiritual identities interacts with several other self-identities. Those themes are support and dependency on spirituality, anchoring identity in spirituality and religion, and identity and spirituality must coincide else tensions arise.

Toldson and Anderson (2010) decided to look at the connection between religion African Americans prior to college. Their study included data from 6795 African American, Latino, and White students in the eighth and tenth grades. Three research questions guided their study. First, did students who participated in more religious activities and have stronger religious convictions have higher grade? Second, did these same type of individuals display characteristics that are associated with achievement including positive self-concept? Finally, the authors wanted to compare religions activities and convictions of different races to the positive academic characteristics.

They found that students who participated in more religious activities, regardless of race, reported making higher grades. Also, African American students who reported making D's and F's reported higher religious convictions that Whites who reported

making A's. Finally, all students who displayed positive attributes associated with academic success were more likely to participate in more religious activities.

Different from Toldson and Anderson (2010) who chose to study students prior to enrolling into college and Dancy (2010) whose study included undergraduates, Jett (2010) analyzed the education experience of four educationally successful African American males in graduate school. Moreover, the author included his own experience as an African American male and the role spirituality played in his life.

The research questioning guiding his study was what factors African American men attribute to their success majoring in mathematics. Using the qualitative methodology of cases study, the author discovered a common theme that was not unique to religious affiliations or denominations. That is, they lived their lives deeply rooted in spirituality and their spirituality led them to fulfil their academic goals.

While the previous studies looked at the experiences of African Americans and African American males, McCray, Grant, and Beachum (2010) sought to fill the gap in the literature of the role African American churches can play in the success of African American students.

They attested that African Americans bring non-traditional capital with them to school and African American churches need to do a better job enhancing them. The capitals the authors spoke of were aspirational, linguistic, familial and social, navigational, and resistant. African American churches should lead the charge of providing school officials the knowledge of these capitals. In order to accomplish this goal, they recommended several methods including developing a school-community

committee, after-school mentoring clubs, community nights, weekend school, and collaborative community service.

The previous studies helped to validate the latent religious undertones of participants in this dissertation. The dearth of such studies indicated more research is needed to specifically analyze the role of religion and spirituality of African American males at various stages of their educational careers across denominations and across the country.

#### Limitations

Participants in this study attended different colleges and majored in different STEM degrees, but attended the same high school. Future studies can be conducted at different schools in different settings to validate the findings in this study. For instance, will the same essence be revealed from four African-American males in a rural school district in the northeast part of the United States? Additionally, future studies can be conducted to examine of African American males who attended majority Caucasian high school experience the same essence.

#### Discussion

Readers of this study may find it alarming that the participants spoke overwhelmingly about their science experience in high school over any of the other disciplines. Litzler, Samuelson, and Lorah (2014) provided a rationale to validate this finding. In their study they decided to combine student's ability to succeed in college engineering, science and mathematics courses into one variable. They cited Sinkele and Mupinga (2011) in that engineering is closely related to science and mathematics in public perception. Furthermore, this ideology is related to self-confidence and

phenomenology rather than other methodologies such as self-efficacy where the former is not domain specific whereas the latter is.

Additionally, one of the participants chose to attend a community college instead of a four-year institution to pursue a non-traditional STEM degree: nursing. Hagedorn and Purnamasari (2012) examined the role of community colleges in science, technology, engineering and mathematics. What they found was that community colleges traditionally service traditionally underrepresented groups in STEM such as African American males. They also stated that there are an increasing number of STEM fields that do not require a bachelorette degree and the fields are “living wage” (p. 156). Therefore, students who do not fit the traditional mold of a four year college and university may find it beneficial to enroll into a community college to earn an associate’s degree or a certification. Either of these options contains the possibility of opening the doors to prosperity that STEM offers.

Since their departure, the school has changed from a magnet program to a smaller learning community (SLC) within the school. There are two differences between the magnet program and the SLC. First, students are not selected and must live inside of the school zone unless granted special permission from the district. Second, the science and mathematics pathways were replaced with Career, Technical and Agricultural Education pathways. Those pathways are engineering and biotechnology. Both pathways begin in the ninth grade and are designed to culminate with an internship during the senior year. The engineering pathway begins with Foundations in Engineering and Technology, then Engineering Concepts and finally Engineering Applications. Similarly, the

biotechnology pathway begins with Introduction to Healthcare Science, followed by Introduction to Biotechnology and finally Applications of Biotechnology.

#### Future Considerations

Further research should be conducted in the area of early interventions to spark interest in science, technology, engineering, and mathematics. Some studies indicate student's interest in STEM begin as early as elementary school (Berry, 2005; Subotnik, Tai, Almarode, & Crowe, 2013). This finding was echoed in two of the participants from this study. Paul stated that he read *Gifted Hands* (1990) by Dr. Benjamin Carson as a youngster and that was his eye-opening moment that sparked his interest in becoming a neurosurgeon. Matthew's interest in forensics science also started prior to high school by watching shows like CSI. By the time he was old enough to attend high school, he knew that he was going to matriculate in a program of study that was STEM related, either at his zone school or the science and mathematics magnet program he would eventually be accepted into and graduate. Studies at every level of the K12 pipeline (Harper, 2012) could prompt school districts to develop STEM themed feeder patterns and these schools would implement those findings that increase the likelihood of students not only majoring in STEM as undergraduates, but persisting on to graduation.

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