Exploring STEM Identity Development, Academic Motivation and Problem-Solving Preferences of African American Men Pursuing Undergraduate Degrees in STEM

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Abstract

Science, Technology, Engineering, Math (STEM) and agriculture are rapidly growing fields and important disciplines for meeting the needs of a growing population, including those related to food access and sustainability. However, there are not enough qualified employees entering into these fields, and additionally, those entering into the fields are not often from underrepresented groups, presenting a need for an increased push to boost the entrance and retention of minorities into degree programs that will prepare them for employment in fields of STEM or agriculture. African American men are one population that has even more disparate numbers of students entering and persisting in these fields and there exists a gap in information about the lived experiences and perceptions of members of this group within this field. This study utilized a phenomenological lens to explore the experiences of self-identified African American men currently enrolled in a STEM or agricultural degree program. Individual problem-solving preferences, academic motivation and subscription to black identity were examined using a conceptual framework adapted from Kirton's Cognitive Functions schema and the Organismic socio-behavioral perspective. This conceptual framework was viewed through a lens of critical race theory in order to determine the salience of these factors on the development of a STEM identity among African American males. The results of this study interrogate current educational practices to provide information about student perceptions, experiences with belonging and coping strategies utilized to overcome real and perceived barriers to STEM or agricultural degree attainment giving voice to this underrepresented group. Data from this study provide information to better inform STEM recruitment and retention practices and include recommendations for future research.

General Audience Abstract

STEM and agriculture are two of the most rapidly growing fields within our time and important disciplines for meeting the needs of a growing population, including those related to food access and sustainability. However, there are not enough qualified employees entering into these fields, and additionally, those entering into the fields are not often from underrepresented groups, presenting a need for an increased push to boost the entrance and retention of minorities into degree programs that will prepare them for employment in fields of STEM or agriculture. African American men are one population that has even more disparate numbers of students entering and persisting in these fields. This study utilized a phenomenological lens to explore the experiences of self-identified African American men currently enrolled in a STEM or agricultural degree program. Problem-solving preference, academic motivation and subscription to black identity were explored through a critical race lens, using a conceptual framework adapted from Kirton's Cognitive Functions schema and the Organismic socio-behavioral perspective interrogating student experiences, perceptions of belongingness and coping seeking to determine the salience of these factors on the development of a STEM identity .

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those that I've met at other points in life. There are many to name, and I am forever grateful for

your support.

Dedication

This work is dedicated to the memory of my great-grandparents, Jeff W. Blackwell & Louise H. Blackwell, fondly known as "Daddy Jeff" and "Mama Louise," who started me on this path many years ago, by facilitating my love for agriculture, encouraging my curiosity in science and instilling in me the importance of giving back and helping people. I hope I live a life that makes you proud.

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Chapter One

Introduction

This is the first chapter of a five-chapter dissertation. The first chapter is introductory and provides an explanation and overview of professional identity development, providing the background and context for the study as well as introducing the problem and conceptual framework utilized in this study. In addition, this chapter addresses the purpose and significance of the study, including assumptions, limitations and a definition of terms. Chapter two, the literature review, examines factors impacting the target population in addition to describing the conceptual framework and other theories utilized within the research. Chapter three describes the research design and methodology, including an explanation of the methods, instrumentation, procedures and data analyses used within the study. Chapter four provides the results of the data analysis and procedures utilized to respond to the research question and the resulting themes. Lastly, chapter five provides discussion, implication and recommendations based upon the results of the study and information described in the literature.

STEM Identity Development

The development of a Science, Technology, Engineering and Math (STEM) identity is important for the self-efficacy and persistence of students within the STEM field (Flowers, 2016). For purposes of this study, science or STEM identity is defined as: "who students are, what they are capable of doing and what they aspire to do and become as it relates to science" (White et al., 2018). While past research has focused on increasing the participation of African Americans in STEM, few studies have explored the processes of assimilation into STEM culture, and the positive roles of culture and academic strengths on student STEM identity (Collins,

2018). African Americans as a whole are significantly underrepresented within STEM fields and present a unique case as they navigate the STEM environment negotiating both racial and science identities. White et al. (2018) found that understanding how a student navigates their science identity is connected to the way in which they view themselves, and the view of science by those in their communities and environment. Unfortunately, for African American students, STEM identity and ones' racial identity may be perceived to be in conflict with one another, leaving students to prioritize one identity over the other (White et al., 2018). The lack of diversity representation in the sciences often means that those entering into the STEM fields are often first-generation STEM students who may not have the resources or mentors that can assist them with information on how to navigate within a university setting or within STEM culture. The behaviors or social norms that a student may have used within his or her personal life, may not be the same on the college campus or within a STEM field. Navigating the differences in these spaces can cause internal conflict or cognitive dissonance as interpersonal interactions and expectation within the STEM field may conflict with a student's personal style, behaviors and conditioning.

Situational Background

Agriculture is integral to the wellbeing of our nation, as well as the STEM fields offering some of the most exciting and rewarding careers in a changing agricultural workforce landscape. However, the number of minorities pursuing careers in these areas is disproportionate to that of their white counterparts despite a growing number of positions within agricultural STEM fields (Estrada et al., 2016; National Institute of Food and Agriculture, 2014). According to the United States Department of Agriculture (USDA) there are nearly 60,000 job openings for students with

agriculture degrees including areas in general agriculture, food, renewable natural resources and the environment yearly; with only approximately 35,000 total graduates available to fill these positions. Of these jobs, approximately 27% will be in STEM related fields (Goecker et al, 2015). Data related to the future agricultural workforce impresses upon educators and industry members that there is a need to encourage more students, including those from traditionally underrepresented minority groups to pursue agriculturally related STEM careers. In addition to filling the gaps in employment within STEM and agriculture, underrepresented minority students bring divergent perspectives and ideas based upon their backgrounds and experiences that can offer thought-solutions to some of the more complex issues facing STEM and agriculture.

Educational Inequity

Common barriers impacting the retention and persistence of African American men in STEM are often rooted in K-12 educational inequities resulting in unpreparedness for the rigor of collegiate science in addition to the navigation of what can be conflicting expectations between racial and STEM identities. Many of the disparities within K-12 education can be tied directly to socio-economic status, with students attending schools in low-income areas or with larger minority populations, having fewer resources, including less access to quality teachers in addition to fewer honors and AP course offerings (Dodge, 2018; Ndura et al., 2003). In a study by Ferguson (2001), minority adults described teaching young African American men strategies to "camouflage their blackness" so that they would blend in with the dominant culture and how to act in obeisance as a method of survival within the dominant culture (Ferguson, 2001). Actions such as these indicate the notion that one's racial identity must be hidden or that certain aspects of it must be withheld in order to be successful. Understanding of this concept is an

important aspect of understanding the methods that minority students use to gain acceptance into the STEM field. Given these cultural practices by minority groups, it stands to see that professional identity, much like that of social identity, is very much a product of social relationships. The expectations of group members as well as personal experiences govern behaviors which can be fluid and changing dependent upon the environment. Societal beliefs, values, interactions and expectations in addition to personal experiences as well as both formal and informal bureaucracies all influence ways in which professional identity is envisioned or enacted (Shoulders & Myers, 2011). In addition to the disparities in STEM educational offerings afforded to many minority and low-income students, economic status in addition to race/ethnicity were often indicators of the rate of summer learning loss experienced by a student with students of color often experiencing more significant learning losses (Garvin-Hudson & Jackson, 2018). Atwater (2000) examined the inequities in precollege science for African Americans and found that in addition to education inequities regarding funding of science education and a lack of qualified instructors, the science curriculum and methods of teaching and learning are more generally not culturally relevant to African American students, failing to demonstrate how or why educational materials can be used in their everyday lives or environments. These inequities within education influence what counts as knowledge within the classroom, teacher expectations, learning outcomes and student understandings of science (Atwater, 2000). Similarly, these factors play into inequities in the number of students entering into fields of technology, engineering and math which require proficiency upper level math and science courses.

Stereotyping

In a study by Garvin-Hudson and Jackson (2018), it was found that the STEM interests of students of color was significantly stimulated by interactions with instructors from similar backgrounds and through the usage of culturally relevant pedagogy. Culturally relevant pedagogy is a method of strength-based learning that promotes identifying positive attributes unique to a students' cultural backgrounds and utilizing them to create linkages between classroom knowledge or learning and cultural knowledge allowing learners to (Ladson-Billings, 1995 & Lim et al., 2019). The inclusion of culturally relevant pedagogy within the STEM curriculum is relevant to this study because it will allow minority group members to better envision themselves and the contributions that they can make within the STEM field, subsequently increasing the development of a positive STEM identity.

Many students within the study associated STEM careers with people of Caucasian and Asian descent, devaluing their own identities and abilities to succeed as African Americans within the STEM field. Similarly, some educators may view African American students through the deficit perspective, assuming that they have little or inferior science knowledge and understanding (Garvin-Hudson & Jackson, 2018; Atwater, 2000). African American men, who may combat internalized stereotypes about STEM, must also combat wider public stereotypes about black masculinity, which may include perceptions related to being angry, problematic, threatening or criminal (Quaye, 2017; Kleider-Offutt et al, 2017). The negotiation of their identities as black men within a public space and as members of groups that are underrepresented in STEM and agriculture can be internally problematic. Stereotypes and media influences that display negative stereotypes about African American men may be inhibitive to the full development of a STEM identity and the immersion of African American men into STEM

cultures. The negotiation of individual identities in conjunction with the need to overcome negative stereotypes may create feelings of imposter syndrome causing them to doubt themselves, their abilities, and have a lowered sense of belonging within the field (Ramsey & Brown, 2018).

The Culture of Higher Education

STEM and agricultural environments, at both research and practitioner levels, remain as environments that are often socially stratified by race among other factors (McGee & Bentley, 2017). Bernal and Villalpando (2010) discussed the "legitimate" knowledge of faculty of color and the power processes that establish what "legitimate" knowledge consists of, describing the ways that the dominant culture has effectually influenced scholarship to portray persons of color negatively by highlighting deficiencies; negating the research and scholarship produced by persons of color, noting it as biased (Bernal & Villalpando, 2010). This brings one to question which knowledge and whose knowledge is deemed appropriate for higher education as well as what criteria makes this knowledge valuable and credible. These ideologies can negate the knowledge of marginalized populations. Smith, Yosso and Solorzano (2007) discussed the presence of racism against minorities enrolled in historically white college campuses. During this study, they found that the passing down of racialized ideologies between generations and had an effect on the socialization of students, especially those who identified as black males (Smith, et al., 2007). Although diversity and inclusion initiatives are widely discussed within higher education, the dismantling of systemic structures and processes that undermine these initiatives are harder to address (Iverson, 2007). Given the issues surrounding the legitimization of knowledge and experiences outside of that of the mainstream population, it is imperative that

scholars begin to document various forms of knowledge and knowing in an effort to allow them to be more recognizable to those who do not hold membership within their groups. The current culture of higher education supports the need and use for many of the tenets of described in critical race theory, including normalcy of racism which is overlooked and therefore unaddressed and the perceived incompetence of students of color, resulting in the dismissal of student knowledge or expertise.

Problem Statement

STEM and agriculture are some of the fastest growing employment sectors within the United States workforce. While significant strides have been taken to mitigate skills gaps between American employers and potential employees, there is still a significant issue surrounding the diversity of persons entering into the STEM and agricultural based fields. Business leaders from throughout the nation are beginning to acknowledge that diversity is an important factor in the success of a company as it contributes significantly to innovation (Hunt, Layton, & Prince, 2014). Accordingly, it stands to reason that diversity within STEM and agricultural education is similarly important. Developing a diverse pool of students is essential to preparing the talent needed to reflect a diverse workforce, which provides variation in thought and delivers new solutions to the problems of the future (Klunder, 2014). Some of the more direct benefits of greater levels of diversity have been found to be a variety of different personal abilities and experiences that tie directly to positive economic growth (Alesina & La Ferrara, 2005). However, the diversity of students within STEM and agricultural programs throughout the United States has not met, nor kept up with the changing demographics of the nation, leaving in

its wake graduates that may not be trained to facilitate relationships within culturally diverse groups (Vincent, Killingsworth, & Torres, 2012).

In addition to the issues surrounding the recruitment of diverse talent into STEM and agricultural fields, exists a disparity in the number of minority students pursuing and attaining degrees within the fields, an issue that can be traced back to problems within the K-12 educational system (Brown et al., 2017). Brown et al. (2017) found that disparities within education have resulted in a lack of science exposure for African American students during a critical time in which most students are deciding their future career trajectories (Brown et al., 2017). This limited access and exposure to STEM coursework and activities compounded with a lack of minority representation within the field can hinder or inhibit the development of a STEM identity and the likelihood of an African American student to pursue and persist a STEM based degree program. Further compounding issues surrounding the number of minority students entering into STEM fields, is a gender disparity among minorities, particular as it relates to African American males. Given these factors, it can be inferred that this population often faces multiple barriers to educational achievement and have limited opportunities to pursue and complete STEM degrees.

Conceptual Framework

Understanding how people from underrepresented groups experience relationships within an Agricultural-STEM career pathway is complex and encompasses a number of various factors. To build information about the lived experience of persons of color, it is critical to use an established framework to form and structure the research process. Further, employing an established framework will help to connect the research findings and conclusions to previous

research and form a basis for making recommendations for future research and practice. There are several established frameworks that are applicable to the creation of information about how African American males experience professional relationships within agricultural STEM career pathways. The frameworks utilized within this research study are the Organismic Socio-Behavioral Perspective (OSBP) and Kirton's Adaption Innovation Theory with a Critical Race lens (Anderson et al., 2018; Kirton, 2013; Delgado & Stefancic, 2017).

The OSBP model, which describes the reciprocal relationships between expressed identity, observed behavior, and environment, as it relates to motivation, was utilized to inform this framework. Kirton's Cognitive Function Schema, which describes one's cognitive processes and problem-solving preferences based upon behavior and inputs from the environment, is overlain onto the modified OSBP model and both are viewed through a critical race lens. These theories were layered together and utilized to describe the cognitive processes and interrelationships between identity development, motivation and problem-solving preference among self-identified African American males pursuing careers in STEM and agriculturally related degree programs. The conceptual framework will be further discussed in chapter two.

Misconceptions about STEM & Agriculture

Overbay and Broyles (2008) examined the factors influencing student career decisions and found that the fields of STEM and agriculture were often negatively perceived as professions requiring manual work and as being financially risky. However, once exposed to agricultural careers and/or STEM courses connecting the content back to agriculture, students reported fewer negative associations with agricultural careers (Rasmussen et al., 2008). This limited understanding of the breadth of agricultural careers and their relationship within STEM has

significantly impacted the likelihood of students from any racial or ethnic background to pursue agriculturally-based careers.

Purpose & Research Questions

The purpose of this research was to utilize a cognitive lens to examine experiences and factors impacting the retention and persistence of African American men in undergraduate STEM degree programs. STEM and racial identity development will be explored in relationship to cognitive problem-solving preference, performed behaviors, social interaction and academic motivation. Utilizing critical race theory (Delgado & Stefancic, 2017; Zamudio et al., 2011), this research sought to provide culturally rich data about the lived experiences of African American male students as they develop and unite their individual STEM identities and racial identities as they pursue STEM and agricultural degrees.

The intended outcomes of this research include highlighting the unique experiences of African American males in pursuit of a STEM degree as they navigate multiple identities and problem solve in order to overcome real or perceived barriers to degree completion. The guiding research questions are as follows:

1. How does one's expressed behaviors compare to one's problem-solving style, academic motivation and subscription to black identity?

2. Do African American males feel a sense of belonging within STEM degree programs?

3. How are coping behaviors being evidenced among African American men within STEM degree programs?

Significance of Study

There is an increased need for both diversity and STEM trained employees entering the workforce. In a 2014 report published by the STEM Food and Ag Council of STEMconnector found that the creation of new jobs in this field along with the mass exodus of current agricultural professionals has contributed to an average of 11,600 monthly job postings in the field of agriculture and approximately 34,000 people were hired within these field from January to August of 2014 (STEM Food and Ag Council, 2014). A 2015 CNN Money report found that America currently has millions of job openings, more than any at other point since the year 2000. While this is indicative of positive economic growth, it is also a reason of concern because it is demonstrative of a significant skill gaps and shortages among employers and potential employees in the U.S. workforce (Gillespie, 2015). This study contributes to closing the skills gap by determining perceptions of barriers towards degree attainment and retention in the sciences. An understanding of these issues can be utilized to better develop strategies for developing and upskilling workers to enter into the STEM economy.

A skills gap is a term used by employers and policymakers to describe the lack of basic skills necessary for future employees, while a skills shortage refers to the lack of job-related skills associated with particular occupations, such as occupations within STEM (Cappelli, 2015). Technical colleges and industries have begun to develop closer partnerships to address the issues with the skills gap. In the 1990's the federal government instituted workforce training programs and initiatives that transformed the roles of community colleges to support the changing workforce and economy. This significant change, allowed community colleges to better serve the local community by better facilitating partnerships with local industries that allowed them train and recruit local talent for the available jobs (Yarnall, 2014). These partnerships allow new and

dislocated workers to help both citizens and businesses within the smaller community increase their human capital, enabling them to better compete for the jobs of the present and the future (Karas, 2013). While these are significant strides towards closing the skills gap, the growth of the number of minority workers in STEM and agricultural fields, specifically those of African American descent has not been reflective of their presence in the overall United States, where they represent approximately 13.4% of the population (U.S. Census Bureau QuickFacts: UNITED STATES). Understanding how people from underrepresented groups experience, identify themselves among, and cope within STEM and agricultural degree programs is complex and encompasses a number of various factors. Critical race theory provides a unique lens to capture this information from the perspective of members within a marginalized group through the telling of counter narratives. The information derived in this study will help meet the needs of our growing workforce by providing information about the barriers hindering minority entrance or persistence in STEM and information that can inform university recruitment and retention strategies.

This information derived from this study provides a unique insight into the ways that black men negotiate their identities and navigate their experiences within STEM in their own voices and from their own perspectives. It will also provide recommendations and strategies that can be implemented by black men to help overcome barriers and develop stronger STEM identities by sharing the successes of other black men in STEM.

Student Engagement

STEM and agriculture are both fields that are not extremely diverse. Agriculture in particular is a field that many minorities associate with slavery and/or menial labor, and inadequate financial rewards. Additionally, as people continue to migrate from rural to more

urban areas, exposure to agriculture is decreasing and only about 6% of students receive formal K-12 educational training related to agriculture (Smith & Baggett, 2012). Within the context of diversifying the fields of STEM and agriculture, student engagement is of the utmost importance. Friedel and Anderson (2017) detailed the measure of student engagement with agricultural content through cognitive, behavioral and emotional measures, denoting the importance of student effort to learn, satisfaction with learning, and the learning environment and one's adherence to classroom norms. Students that were positively engaged often had higher cognitive performance, a heightened sense of belonging and fewer behavioral infractions (Friedel & Anderson, 2017). By positively engaging students with culturally relevant content, issues related to differences in diversity may be mitigated. These practices will allow students and instructors to assess unconscious biases that may influence one's sense of belonging in their chosen field of study. Those entering into the STEM fields already have commonalities as they both have interests in the STEM field, however other issues, unrelated to STEM may inhibit collaborative work or the development of mutual respect for one another's individual knowledge base.

Mentorship

A study by Moss (2011), assessed the role of summer research and mentorship experiences for underrepresented students in agricultural sciences and found that upon completion of the research experience, students' perception of agriculture changed to become more positive (Moss, 2011). While research and mentorship experiences positively contributed to a change in perception about agricultural sciences, another benefit of mentorship was the socialization of students into the scientific community and increased opportunities for engagement in the research practice. Mentoring relationships also allow for a greater level of

psychosocial support through role modeling, counseling and encouragement. While many have viewed mentoring relationships as being most powerful within same-race or same-gender pairings, mentoring is also effective when both parties have similar values (Hernandez et al., 2017). This study will provide a resource to facilitate more holistic mentoring practices by providing a model that describes the cognitive processes and motivations of African American students. By better understanding the roles of mentorship and role-modeling as they impact the retention and persistence of African American men in STEM, educational institutions can begin to develop and implement retention strategies to increase the successful matriculation of students within this population which will ultimately assist in the development of a diverse STEM workforce.

Assumptions

Several assumptions were utilized to guide this study. Each of the assumptions below describe common issues faced by African American males as depicted by the media and existing literature about those with memberships in the group. These assumptions include those related to social criminalization, double-consciousness and related social pressures and the difficulty in developing a professional identity that contradicts negative stereotypes associated with race and gender. These assumptions operate on both a personal and professional level and have greatly influenced the beliefs and perceptions that those within this group have about themselves and the ways in which they are viewed by others.

African American males are often depicted as aggressive, hypersexual and violent or as gang members, criminals or professional athletes. In response to this, some work to cultivate scholarly identities as an act of resistance to fulfilling the stereotype (Rogers & Way, 2016).

⊡ Double-consciousness requires African American males to simultaneously work within two cultures to negotiate various identities and barriers to social capital development (Woods-Wells, 2016).

⊡ The development of STEM identity among males is influenced by cognitive factors or mental processes in addition to influences from the social environment (Anderson et al, 2017).

Limitations

This study utilized a qualitative research design that was informed by descriptive quantitative data. While all efforts were made to ensure reliability and correct interpretation of data, there are still some limitations that were inherent in this study. The researcher identifies as an African American woman and therefore holds certain biases. In addition, the data collected is self-reported and the researcher had no other resources for evaluating STEM or ethnic identity or relationships outside of student membership or participation within student groups or committees. Additionally, this study utilized a small group of participants, within a field that is not highly diverse and most participants were from predominately white institutions, which may limit the transferability of results to students attending minority serving institutions. However, as with many studies focused on historically marginalized groups, it is important to draw inferences from small, subjective, qualitative data in order to address and critique dominant paradigms. This requires selecting methodologies that correspond to the interest of particular social groups, as was done in this study (Hill-Collins, 2000).

Definition of Terms

Actor – the person performing an action, defining the meaning and context of a situation (White, Klein & Martin, 2015).

Adaption – cognitive preference for problem solving with solutions which are paradigm consistent (Kirton, 2013)

African American – "Black or African American" refers to a person having origins in any of the black racial groups of Africa (United States Census Bureau, 2010).

Behavior – characteristic actions influenced by cognitive function (Kirton, 2011).

Cognitive Affect – compromises needs, values, attitudes and beliefs all of which are associated with motive (Kirton, 2011).

Cognitive Effect – compromises cognitive style and cognitive level manifested through the problem-solving process (Kirton, 2011).

Cognitive Function – composed of three elements "*I do, I think, I am*" which are the influencers on behavior (Kirton, 2011).

Cognitive Gap – the gap in cognitive style (as well as in level, motive, attitude etc.) between problem solvers and the problem, or between the problem solvers themselves, which needs to be resolved in order to problem solve alone or in teams (Kirton, 2011).

Cognitive Resource – knowledge, skills, and other experiences of the individual. The learning outcome of the operation of cognitive function (Kirton, 2011)

Cognitive Style – one's preferred problem-solving preference for adaption or innovation (Kirton, 2011)

Collective Identity – the way in which we understand ourselves as members of a group (Scott, 2015).

Color-blindness – belief that one should treat all persons equally, without regard to their race (Delgado & Stefancic, 2001).

Coping Behavior – behavior not in accord with preferred problem-solving style or comfortable reach of current level (Kirton, 2013).

Critical Race Theory – legal movement seeking to transform the relationships between race, racism and power (Delgado & Stefancic 2001).

Deficit Perspective – the perceived incompetence of students based upon real or perceived deficits in learning or understanding; devaluing cultural knowledge and experiences that students bring into educational spaces (William et al., 2019).

Double-Consciousness – differences between thoughts, actions and experiences of a person (Eyerman, 2001).

Environment – culture and climate, the social environment and perceptions of it (Kirton, 2011).

HBCU – historically black college or university

Impression Management – the attempt to control the images of ourselves that we convey (Scott, 2015).

Innovation – cognitive preference for problem solving with solutions which are paradigm cracking (Kirton, 2013).

Intersectionality – Acknowledges that oppressions come from more than one source and that categorical distinctions do not address the various forms of marginalization one may face at any given time (O'Connor, 2015).

Micro-aggression – smaller encounters with racism/discrimination, usually overlooked by those with memberships in majority cultures (Delgado & Stefancic, 2001).

Phenomenology – the study of experience and of things as they are experienced (Smith, 2016)

Racialization – the process of creating race and/or injecting a racial element into a situation (Delgado & Stefancic, 2001).

Role – expectations attached to a specific position in a social structure (White, Klein & Martin, 2015).

Role Conflict – when one is forced to play two or more roles that conflict with one another (Scott, 2015).

Role Strain – occurs when the actor does not have sufficient resources to enact a role or roles (White, Martin & Klein, 2015).

Social Network – the relationships or ties between individuals, groups, communities, organizations, or societies (Woods-Wells, 2016).

STEM – Science, technology, engineering and math, for purposes of this study, STEM will be inclusive of agricultural sciences

STEM Identity – who students are, what they are capable of doing and what they aspire to do and become as it relates to science, technology, engineering and math (White et al, 2018).

Symbolic Interactionism – concept associated with the social dimensions of the mind and how they interact to form imagination, motivation, perceptions of others, self-consciousness and emotions (Scott, 2015).

PWI – predominately white institution

Summary

This study seeks to examine the processes STEM identity development among African American males within STEM and/or agriculturally related degree programs through a lens of Critical Race Theory and accounting for an individuals' problem-solving styles and satisfaction within their educational program. Highlighting these facets of the STEM experience on African American males may provide insight into the development of more inclusive mentoring and retention strategies for students with memberships in vulnerable populations

Chapter Two

Literature Review

Literature about increasing the participation of underrepresented minorities in both STEM and agricultural sciences often focuses primarily upon issues related to the recruitment of the student such as the alleviation of financial barriers and the implementation of mentorship programs. STEM fields are generally thought of to be culturally neutral, often negating the beliefs and experiences of persons with membership of non-white groups. The dismissal of these beliefs and experiences fail to acknowledge the roles that this expressed identity may play on behavior and cognition as well as the interactions between each of these factors, specifically as it relates to African American male students within STEM and agricultural fields.

As a result of this oversight, this study has been designed to utilize a cognitive lens to examine the factors contributing to the retention of African American men within STEM and agricultural degree programs and the factors influencing their decisions to pursue and remain within these fields. The factors that will be explored within this study include: expressed identity, cognitive problem-solving styles, academic motivation, and their relationships with performed behaviors, and diverse social interactions. Critical race theory provides a critical lens through which to view each of these interactions, accounting for race and perceptions of experiences based upon race, a concept that is tightly interwoven throughout the lived experiences of people of color (Delgado & Stefancic, 2017).

Social Cognitive Theory

Social cognitive theory (SCT), also known as social learning theory (SLT) provides a model by which human behavior can be described. Within SCT, a triadic reciprocal relationship

exists between behavior, cognition, environment and personal factors based upon the concept of reciprocal determinism (Bandura, 1989; Wulfert, 2013). This concept further describes SCT as the process by which one learns via modeling, meaning that one learns and/or forms behaviors based upon social influences (Raicevic et al., 2017). Within SCT, people have the capacity to utilize symbols to process actions and interactions and form internal notions that will shape how they will react or interact in future situations. This meaning making process may impact one's reasoning ability and behaviors as they reconcile past experiences with current and future situations (Bandura, 1986). This concept strategically ties into the concept of self-efficacy, or belief in one's self and one's abilities is paramount to understanding one's attitude and behaviors. Self-efficacy may also play a mediating factor on one's persistence, perseverance which impact performance (Ozyilmaz et al, 2018). This process also influences the development or construction of ones' identity and identification with a group or subject matter (McClellan, 2017). Processes such as these may be detrimental to those seeking entrance into STEM and agricultural degrees and careers dependent upon their processes of self-efficacy.

Symbolic Interactionism

One of the ways in which the experiences of African American males can be described is through the symbolic interactionist lens. Symbolic interactionism considers ones' perceptions and meanings of both personal and individual behaviors in addition to the roles that these behaviors play within relationships (Carter & Fuller, 2016). The behaviors, interactions and cultural norms influence the ways in which persons interact with one another, impacting the culture of a working environment. The processes of professional identity development of when

viewed through an interactionist lens will help inform data about perceptions that may be often experienced by many minorities, yet rarely reported.

Adaption-Innovation Theory

Kirton's Adaption Innovation (A-I) theory provides insight into how people solve problems and manage change regardless of race, ethnicity, and culture; however, it does acknowledge that increased diversity among teams is more difficult to manage, but also required in order to solve more complex problems. A-I theory is operationalized by assigning participants an overall score on a continuum that denotes a problem-solving preference for either more adaptation or more innovation. This score is comprised of three sub-scores for idea generation or sufficiency of originality (SO), methodology or efficiency (E) and management of structure or rule/group conformity (R) (Kirton, 2013). Fundamentally, A-I theory operates under the assumption that there are two inherent problems with every issue that is undertaken, "Problem A," this issue at hand and "Problem B," issue inhibiting a group from working to solve "Problem A" (Kirton, 2011). Many times, Problem B is associated with a team member believing they deserve more of the reward from solving Problem A. Among this study population, entrance into a STEM or agriculturally related degree program would serve as "Problem A."

Bush et al (2017) used the KAI, the corresponding measure of problem-solving style, within the paradigm of cooperative learning to determine how similar KAI scores contributed to positive perceptions of team members. When working with diverse groups, it is important to note that there may be many "Problem Bs," one of which is diversity of problem-solving styles in the team. Therefore, homogenous groups with respect to problem-solving style, are more likely to be able to work together more easily, because problem-solving style is not likely a contributor to

"Problem B's" to overcome (Bush et al, 2017). Although there are significant barriers faced by diverse problem solvers working together to solve problems, having diverse team members is beneficial to solve complex problems. Research has determined that there is not a correlation between race/ethnicity and KAI scores and other significant variables associated with team dynamics, such as motivation, intelligence, learned skillset, age, education, situation and economic status (Kirton, 2013). However there has been differences noted between genders with women tending to have more adaptive scores than men by seven points on average (Kirton, 2013). There are not any known demographic differences outside of gender noted in the inventory, it stands that racially diverse problem solvers manage change using their individual style preference regardless of race.

Personal Characteristics

A-I theory is an important theory for understanding cooperation of people. Within A-I theory, there are a number of traits subscribed to cognitive style with innovators tending to prefer less structure to solve problems while adaptors prefer to problem solve utilizing more structure (Kirton 2011, Skinner and Fox-Francouer, 2010). Complimenting A-I theory is the KAI Inventory, which measures one's predilection to adaption or innovation by determining their problem-solving style, without regards for ability or level (Friedel, 2014; Woods-Wells, 2016). There are three sub-scores within the KAI that make up the entire score. The sub-scores are denoted as (SO), (E) and (R). Each of these factors refers to specific traits such as idea generation, efficiency, and conformity to group or social norms (Kirton, 2013).

     Sufficiency of Originality (SO) – The (SO) factor within the KAI inventory refers to one's preferred style for idea generation, not to be confused with one's capacity

to generate ideas. Those with more adaptive (SO) scores tend to develop fewer ideas that are novel, tried, true and tested; while those with more innovative scores tend to produce a greater number of novel ideas in a shorter amount of time and with lesser chance of success (Kirton, 2013).

- Efficiency (E) – The (E) factor with the KAI inventory refers more specifically to the style differences in the preferred problem-solving method. Those with more adaptive (E) scores generally prefer to problem solve more methodically, working within a defined system, acknowledging numerous details. Conversely, those with more innovative (E) scores prefer to problem solve by working outside of the system, sometimes creating radical changes (Kirton, 2013)

- Rule/Group Conformity (R) – The (R) factor within the KAI inventory, referring to style of rule/group conformity is based in consensual social norms. It refers to the likelihood of one to respond to social pressures to conform to social rules both interpersonal and personal. Within this sub-score, adaptors often follow more closely to rule and group structure as guidelines to affect change, while innovators have less concern for structure, consensus, or tradition. This particular sub-score also has implications for cohesion among groups (Kirton, 2013).

While each of these sub-scores are associated with the social aspects of problem solving, it should be noted that the KAI Inventory is a psychological instrument and that the three sub-scores are not independent of one another; meaning that one cannot score high in innovation in one sub-score and high as an adaptor in another (Kirton, 2013).

Scale of adaption innovation

Adaption-Innovation or A-I theory focuses on the cognitive style of individuals as it relates to problem-solving preference, decision making and creativity, regardless of level, instead focusing on style. This theory posits that a person's problem-solving style falls within a continuum that measures adaption and innovation which can be measured by the Kirton's Adaption-Innovation (KAI) inventory (Kirton, 1984). This inventory has been used in organizations to promote team building and to understand cognitive style differences. Persons with scores differing more than twenty points on the A-I continuum may find that working together may be contentious because of the tremendous difference in problem-solving style. Persons operating with environments where team members have significant differences in problem styles must exhibit coping behaviors in order to adapt to the problem-solving style necessary to work through the situation (Kirton, 2011; Friedel and Rudd 2009). The A-I continuum has a scale of 32 to 160 with 32 being more adaptive and 160 being more innovative. The mean score of the overall population is 95 points. Men tend to score somewhat higher with a mean score of 98 points, while women tend to score closer to 92 points on average (Woods-Wells, 2016; Kirton 2011).
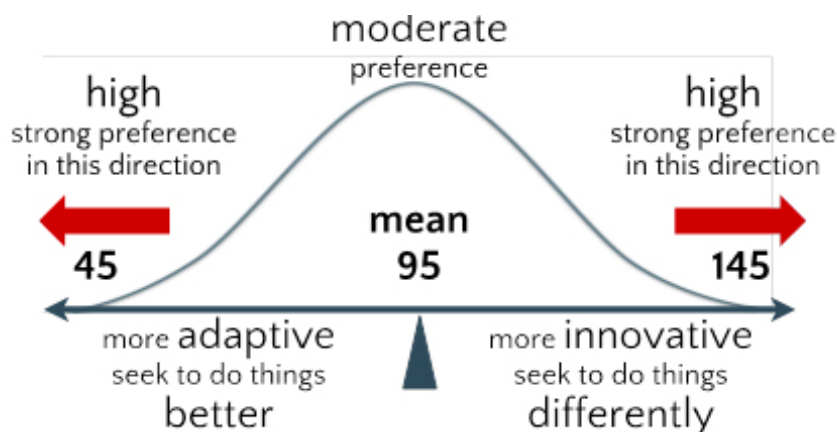
Figure 1: KAI Continuum

Coping behavior

Coping behavior associated with KAI refers to one's operating outside of one's preferred problem-solving style, either by being more adaptive or more innovative. Coping generally occurs when there is a cognitive gap between two people, or a cognitive gap between the problem solver and the problem. Coping works along two axes of intensity (degree of being more adaptive or more innovative) and duration (amount of time spent coping) and is fueled by motive (Kirton, 2003). Motive works to help one expend additional energy and withstand the discomfort that may be associated with working outside of the limits of one's preferred style. Behaviors indicative of coping may not be readily noticeable depending upon how much one has to cope and the amount of time spent coping. Unlike one's preferred problem-solving style, coping behaviors are variable, and learned from one's past experience (Kirton, 2011).

Environment

Environment within the context of A-I theory is a term that is inclusive of both culture and climate or one's social environment and reality. This concept implies that one's experiences within the world around them significantly impacts both their behaviors and perceptions of the world around them, as well as where one may perceive opportunity. This is a continuous cycle of feedback that impacts one's cognition, influencing one's self-image and motivational factors (Kirton, 2011 p. 41-42).

Kirton's Cognitive Function Schema

Kirton's Cognitive Function Schema demonstrates the interrelationships between human behavior, cognitive function, and the environment. Within the realm of cognitive function,

Kirton (2011) identifies three interrelated elements: cognitive effect, cognitive affect and cognitive resource. Each of these elements interact within the schema with behavior and environment producing a product.

Cognitive Effect

Cognitive effect refers to one's preferred style within adaption-innovation theory by way of cognitive process. This element of the cognitive schema also incorporates one's potential level or IQ, demonstrating how both interact to help one determine or plan individual problem-solving solutions while each maintaining independence of the other. (Kirton, 2011 p. 39-40; Woods-Wells, 2016). While this factor of the cognitive function schema refers to IQ in regards to potential level, it does not necessarily refer to IQ testing whose usage is contentious among minority groups who have historically been intellectually maligned by the Eurocentric standards used to validate and measure tests of level (Laundra & Sutton, 2008). The cognitive function schema and related measurement of style via the KAI inventory has been applied among numerous racial and ethnic groups with evidence supporting its validity, using potential level as a measure of intelligence beyond the use of IQ testing.

Cognitive Affect

Cognitive affect refers ones needs, values, attitudes and beliefs which are associated with motive. This factor refers more specifically to how one places value on the problem and how they prioritize the problem-solving process with respect to needs, values, and motives. Within this aspect of cognitive function, one chooses how they want to go about solving a problem

based upon the structure of their beliefs, attitudes and values (Kirton, 2011 p. 39; Woods-Wells, 2016).

Cognitive Resource

Cognitive resource is comprised of one's experience, knowledge and skills. It is an outcome of cognitive function and specifically associated with learning and memory. Within this aspect of cognitive function, problem solving occurs alongside learning and is stored in memory (Woods-Wells, 2016; Kirton, 2011).

Behavior

Behavior within the cognitive function schema is a result of the cognitive process informed by variables associated with cognitive affect, effect, and resource; as a chosen response to the environment. However, behavior is mutable and one may choose to change behavior based upon perceived cognitive gaps or differences in preferred problem-solving style. When working in teams or on new problems, one may need to solve a problem using a style different from one's preferred style. This will force one to produce a change in behavior, exhibiting coping to achieve a desired solution or product (Woods-Wells, 2016).

Critical Race Theory

Strides towards equality and civil rights for minority groups in America have been slow to occur and often dismissive of the generational traumas resulting from hundreds of years of mistreatment and disenfranchisement. Critical Race Theory (CRT) was developed as a result of the application of practices related to critical legal discourse which identifies race as a central tenet in the organization and governing of the social and economic structures of the United

States. CRT is also being applied within the education realm to understand disparities and to identify and remedy imperialist pedagogy. CRT specifically focused on the intersectional relationships between race, racism, state juridical and legal power. This theory seeks to understand and change the inequitable social norms as it relates to racial hierarchies. Further, it has been applied to an array of various topics and subject areas such in a push to bring light to social justice issues. Within critical race theory, there are six central tenets including:

- The normalization of racism or colorblindness - This tenet posits that racism is a standard component of everyday life and that has benefited white supremacy and that notions of equality fail to recognize or remedy the prevailing injustices that resulted from historical racism

- Interest convergence - This tenet posits that in order for a minority group to receive concessions, they must advance the interests of majority groups.

- Race is a social construction - This tenet posits that race is not a biological concept, but the product of social though and relations.

- Racism is differential between minority groups - This tenet posits that minority groups are racialized differently and experience racism differently.

- Race is an intersectional issue - This tenet posits that race is not a singular issue, but intersectional, traversing multiple identities.

- Minority group members have a presumed competence to speak about racial injustice experiences to non-minority group members - This tenet posits that those with membership in minority groups can speak on the behalf of minorities to non-minorities.

(Delgado & Stefancic, 2001; Delgado & Stefancic 2017).

Critical race theory addresses a number of the issues surrounding race, including those of related to colorblindness, power dynamics and the concept of interest convergence. The concept of interest convergence, can be a considerable hindrance to minority advancement as one must essentially "prove" why diversity or liberatory practices are beneficial to both minority and majority groups. Once finding solutions are no longer beneficial to the majority group, the issue becomes "divergent" and is often dismissed, making solution implementation harder, if not impossible to implement. (Delgado & Stefancic, 2001; Brown, 1980). Within the realm of STEM and agricultural education, it can be argued that the current push towards diversity and inclusion is also a case of interest convergence. Meanwhile, the colorblindness viewpoint fails to acknowledge racial disparities that impact STEM readiness and exposure. As the United States seeks to improve its rankings and competitiveness within STEM and agriculture, it is imperative that they begin to utilize a critical race lens to address issues related to diversity recruitment and retention. Within this study, Critical Race Theory will be utilized as a lens within to bridge the domain between the psychosocial environments as experienced by participants in this study and the cognitive aspects of research study participants. This theory will facilitate a critical consciousness of race and power dynamics that often inform educational systems, allowing for the research to be more culturally sensitive (Cerezo et al; 2013).

The Myth of Colorblindness

The social construction of race was first acknowledged in writing by Robert Park, who promoted the ethnicity paradigm using race as a small factor within a number of factors that sum-totaled ethnicity, leading to the recognition of race as a social construction. Within the ethnicity paradigm, Park believed that minority groups should severe ties with other cultures and

assimilate within the dominant culture, leading to the melting pot ideology (Fitzgerald, 2014).

The phenotypical representation of race can be seemingly contrary to race being a social

construction. However, the social construction of race is justified because existing racial

categories have been developed or changed due to various circumstances throughout history.

Current racial designations were created by legislation throughout the twenty-first century

(Obach, 1999). The social construction of race and its dismissal as a causal factor for differences

among people indirectly influences the beliefs and ideation of colorblindness, which effectively

dismisses issues related to race, such as racism that arises due to individual personal perceptions

about race.

Race within Research

Quantitative research has often ignored the plight of minorities groups, neglecting to

address their concerns or seeking to review their concerns through a lens of colorblindness or

with methods that inadequately addressed concerns, that were culturally biased or inappropriate,

or that exploited the research participants. Traditional education and qualitative methods

throughout the United States have been dominated by paradigms reaffirming white supremacy,

subconsciously seeking to minimize differences and reproduce concepts of whiteness within

diverse populations to shape the model minority. Critical Race Theory interrogates race within

qualitative research, analyzing the systems of racism and its pervasiveness by better addressing

the positionality of the researcher (Parker & Lynn, 2002). Previous history and research has

indicated quantitative research to be non-biased, specifically focusing on numerical data,

overlooking issues with resources or access that may skew quantitative data. Today, strict

quantitative research has been deemed to be somewhat limiting in its representation of

marginalized groups because it "lumped" similar categories together, often overlooking or minimizing salient data points in addition to assigning limited categorizations (Kwan & Schwanen, 2009). In recent years, strict quantitative research has been deemed to be somewhat limiting in its representation of marginalized groups because it "lumped" similar categories together, often overlooking or minimizing salient data points in addition to assigning limited categorizations (Kwan & Schwanen, 2009). Within minority and marginalized groups, it is imperative that one ensure that quantitative research procedures meet the need of the population without exploitation or further marginalization of the population. Within critical quantitative research, it is important that one recognize the differences between universalistic and relativistic approaches to the data collection and analysis. Universalistic methods of inquiry such as standardized testing, which are used to determine aptitude, greatly defining a student's career trajectory, subscribes to a strict order of theory and testing, drawing conclusions from statistical inferences. However, currently utilized theories and tests were most often designed to fit the needs of majority groups, often marginalizing those without membership in those groups through bias, inhibiting the researcher from noting important differences between in groups (Padilla, 2004). An example of this would be standardizing testing which has often been found to be a poor indicator of achievement among minority students. These research approaches are centered on the prevailing white culture and the norms associated with it, creating standards or benchmarks that continually marginalize non-white groups.

The STEM workforce, continues to be dominated by a culture that is rooted in dominant paradigms that often exclude embracing diversity. Deconstructing these dominant paradigms is pertinent to creating a more equitable and inclusive society, therefore, it is imperative that a

social justice lens such as critical race theory be applied to teaching and learning within the K-12 and higher educational systems.

Organismic Socio-Behavioral Perspective

The Organismic Socio-Behavioral Perspective (OSBP) is rooted in the work of Bandura's Socio-Cognitive Theory (SCT) and the Self-Determination Theory (SDT) posited by Deci and Ryan (2000). SCT is represented by a triadic model that describes the interactions between the environment and cognition that influence behavioral change. Deci & Ryan (2000) utilized the term organismic to describe the importance of environment and its impacts on motivation, to better describe the complexity of motivation as it relates to self-efficacy (Mitra, 2017). Anderson (2007) expanded this work utilizing a grounded theory approach to create the organismic social cognitive perspective (OSCP) to be utilized in structured learning environments. This framework focused more specifically on self-determination than self-efficacy and posited one's motivation was a better indicator of the personal driving forces that were pertinent to predicting behaviors (Anderson, 2007; Mitra, 2017). The OSCP model was then expanded up and adapted by Anderson, Woods-Wells, Amal, Bass, and Simpson (2018) to create the organismic socio-behavioral perspective (OSBP). This adapted framework is better utilized to study motivation of persons with memberships in marginalized groups by incorporating expressed identity in the place of personal factors which include cognition, affective and biological events (Anderson et al; 2018). Understanding how ones expressed identity and STEM/agricultural environment impact or influence observed behaviors can be useful to understanding the cognitive processes related to the experiences of African American men and the negotiation of their STEM identities.
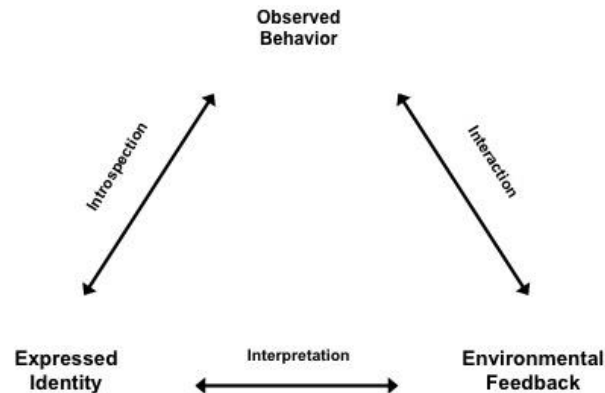
Figure 2: Conceptual Model for the Organismic Socio-Behavioral Perspective (Anderson et al; 2018)

Conceptual Model for the Study

In order to understand the factors influencing the retention of African American males within STEM and agricultural degree programs, is an understanding of the co-influential intersectional nature of cognition, identity and environment. Kirton's cognitive function schema will be used to describe problem solving styles (Kirton, 2011, p. 37). Anderson's organismic socio-behavioral perspective will be utilized to describe the interrelation of identity, behavior and environment and critical race theory will be presented to demonstrate the possibility of the pervasiveness of race in both the historical and contemporary contexts. Kirton's schema will be overlain with OSBP and critical race theory to create the conceptual framework for this study.

Aspects of the Conceptual Model

The integrated conceptual model combines several aspects of OSBP and Kirton's Cognitive Function Schema. The table below details which concepts from each model have associated within the conceptual framework. Behavior and environment are common between both of the original models.

Interaction, Introspection and Interpretation

Interaction, introspection and interpretation are each constructs within the OSBP model. Within OSBP the model, interaction refers to reciprocity between one's observed behavior and environmental feedback or social evaluation via group dynamics. Introspection within the conceptual model is a expressed by the reciprocity of cognitive function or expressed identity and observed behaviors, demonstrating the processes of self-analysis via the cognitive process.. Lastly, interpretation within the conceptual model as well as within OSBP model refers to the synergies between expressed identity and environmental feedback and interpretation or meaning making. These functions are the thought processes associated with each domain of Kirton's cognitive function schema (Kirton, 2003; Anderson et al; 2018). The blue text within the model represent elements of Kirton's Cognitive Function Schema, that were overlain onto to OSBP model, while the red texts represents critical race lens that will be utilized to contextualize the results of the study when analyzed using this framework.
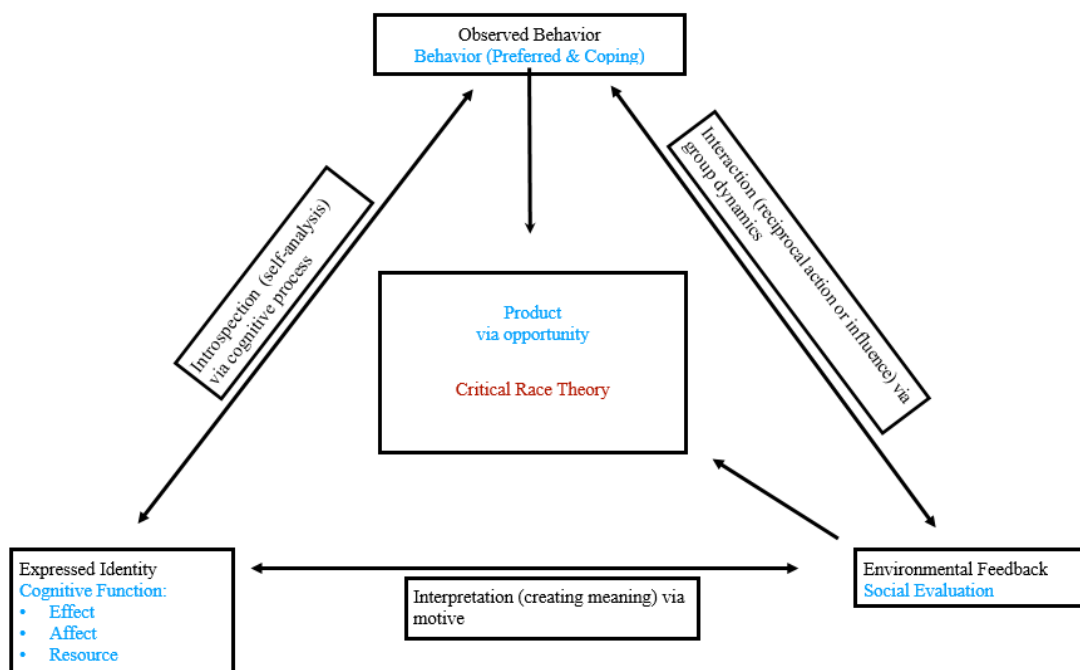
Figure 3: Cognitive Socio-Behavioral Perspective Conceptual Model

Conceptual Model in Action

In order to better demonstrate the salience of this model and its function within this study, a sample vignette has been created.

Jamil is a twenty-year old African American student attending school at a large research institution. Two years ago, he decided to attend college to pursue his degree in computer science after being encouraged by a speaker in a workshop held at the community center in his home town (interaction). *Jamil plans to use his degree to work for an agricultural company developing automation software. Prior to attending this workshop, Jamil had never considered college or a professional career* (introspection). *Many of his high school classmates that decided to attend college came home after the first semester and never returned to complete their degrees because of the cost and they often spoke of issues acclimatizing themselves to both their peers and the collegiate environment. Fortunately, Jamil was able to obtain a scholarship to defray the costs*

associated with his college attendance but his experience was still somewhat difficult. Like his friends, Jamil found the collegiate environment to be extremely different from the environment that he grew up in (interpretation). *Many of the students came from more affluent households where both of their parents had college degrees and professional employment. These familial* attributes allowed them more educational affordances that Jamil's family *could not provide for him. In addition, many of the students seemed miles ahead in terms of knowledge and Jamil often felt as if he struggled to keep up with his studies* (interaction). *Jamil felt that many of his professors and classmates believed him to be lazy because he did not have some of the same foundational knowledge that his classmates had obtained* (interpretation). *Even when Jamil was confident about his contributions to in-class discussions or assignments, he found himself fighting to be taken seriously and was even once accused, but found innocent, of cheating on an assignment. As a result, he found it hard to obtain information about internships and other external opportunities that he believed would be advantageous to his matriculation in his degree program and future career advancement* (interaction). *Compounding these issues, Jamil overheard a classmate expressing apprehension about working with him on an upcoming* assignment because his " urban" image and his usage of slang terminologies made th*em feel threatened* (interpretation).

Within this model, elements from the conceptual model are evidenced as Jamil seeks to navigate the STEM environment. The vignette depicts a constant evaluation of Jamil's behaviors, cognitive processes, perceptions of interactions within the STEM environment and how they impacted Jamil's experiences. The vignette also depicts elements of critical race theory

Expressed Identity and Academics

The development of identity and the understanding of self are two facets of life that are constructed based upon shifting self-representations that promote an "illusion of wholeness." For those that are members in majority groups, overall identity, or illusion of wholeness may involve the melding together of professional, social and collective identities such as, teacher, fireman, brother, father, friend, etc. For persons within minority ethnic groups, the illusion of wholeness involves not only the melding of professional and social identities, but it also often involves the development of identities that govern behavior and perception among both minority and majority groups. These identities and the self-perceptions associated with them are often vastly different. As one grows, a person's self-conceptions tend to form based upon the internalization of how others see and treat them (Josselson & Harway, 2016 pp. 13-16). Scott (2015), describes identity as multidimensional, fragmented and resistant to definition. A person possesses multiple identities that coalesce to form his or her overall identity. As a person embodies each of these various roles, there are certain behaviors that are automatically assumed or expected of them (Carter & Fuller, 2015). For example, when acting in the role of a teacher, one cannot easily act in the role of a friend. These roles can cause conflict between one another; however, a teacher must reconcile all of these roles into him or herself and only act within the role of friendship when the time is appropriate.

In addition to the complexities associated with role and identity development, writings about culture and race have constructed the ideas of otherness and its perception as a threat. Using this definition, identity can be defined in terms of something that one does, creates or receives, which often reflect the ideals of those within majority groups (Scott, 2015, pp. 8-9). For those with membership in minority groups, particularly persons of color, the journey towards a

wholeness of identity can be increasingly difficult given sustained cultural traumas such as disenfranchisement stemming from negative historical experiences, leading to the development the duality of identity or what W.E.B. Dubois referred to as "double-consciousness" (Eyerman, 2001, chapter 1). Double-consciousness occurs when one has to fulfill roles or duties that are perceived to be in conflict with one another. Evidence of double-consciousness and this duality are often signified by the differences between thoughts, actions and experiences of a person. Other examples of this can be found among various African American professionals. Bell (1990) gives reference to the biculturality of development amongst African Americans, suggesting that African Americans are socialized into two cultures simultaneously, the African American culture in addition to the culture of white America. This socialization requires the African American professional to structure his or her life in a manner that "roots" them to their heritage while also assimilating into the mainstream society to a point that allows them entrance into areas dominated by white culture (Bell, 1990). Given the ways in which self-conceptions form and the potentially negative issues associated with the embracing of one's cultural identity, one can begin to draw parallels between the development of self-conception, perceptions of social capital and the disparate numbers of African American males in fields of agriculture, science, technology, engineering and math.

Education and Black Identity

For African American students entering into to colleges or universities, the student development process may be different than that of others. Black identity development, also known as Nigrescence, calls for educational professionals to understand that students from diverse backgrounds may have different developmental processes in college, impacting the ways

in which they should be supported. This concept provides the impetus for seeking to gain a better understanding of the black collegiate student development process. Nigrescence is a term first coined by W.E. Cross Jr. in 1971 and the term "nigrescence" is French for "turning black," alluding to the process of moving from black self-hatred or oppression to black self-acceptance and self-actualization while under oppressive conditions (Vandiver, 2001 and DeCuir-Gunby, 2009).

According to Decuir-Gunby (2009) the process of Nigrescence occurs in several steps which includes:

- Pre-encounter
- Encounter
- Immersion-Emersion
- Internalization
- Internalization-commitment

The model has also been expanded to identify areas of identity that are influenced through various social encounters including those related to assimilation, self-hatred, mis-education, inclusivity and afro-centricity as well as anti-white sentiment (Decuir-Gunby, 2009). A positive racial identity helps to promote one's confidence in their abilities. African American or black students may have had or are currently experiencing issues surrounding racism which may negatively impact their identity development processes creating more barriers to racial identity development than those faced by white students, especially if they are also identified as academically gifted (Ritchey, 2014; Ford, Harris, & Schuerger, 1993). Understanding the concept of nigrescence can better inform student development initiatives and help students to begin to identify with their chosen professions.

Intersectional Identities: Black & STEM

Historically, African Americans have been associated with negative stereotypes such as, aggressiveness, and highly sexual traits that are unacceptable within professional settings or mainstream society. Upon desiring entry into professional groups and associations, especially in fields such as STEM and agriculture, which have low numbers of diversity, these perceptions are detrimental issues that can prove to be a hindrance to the entrance or advancement of minorities in the profession, adding additional stressors as one seeks to distance themselves from negative identity associations. McGee (2016), found that students of color entering into STEM-based studies were often perceived as incompetent, with instructors facilitating an environment that forced students to prove themselves capable of participating in the coursework (McGee, 2016). Compounding these issues are negative stereotypes about the association between agriculture and slavery with limited exposure to the twenty-first century agricultural career pathways which are inclusive of STEM professions (Jacobs, 1998; Beyl et al, 2016; Johnson, 2012). Traditional education throughout the United States has been dominated by paradigms reaffirming white supremacy, subconsciously seeking to minimize differences and reproduce concepts of whiteness within diverse populations to shape the model minority (Teranishi et al, 2009).

The STEM profession has often been exclusionary in nature to those that are not members of the dominating group in STEM profession, white and male. There are many factors that influence African American students' educational aspirations, particularly as they relate to STEM, researchers have found that associations with socioeconomic status is a significant predictor of the pursuit of educational attainment and performance levels in addition to the influence of social relationships (Jorstad et al, 2016). Within STEM and agricultural

communities, minorities have often reported negative interactions with faculty members, staff

and peers, making them feel isolated, threatened or unwelcome (Diefenbeck, 2016; Jorstad et al,

2016). Further compounding these issues are widespread negative stereotypes associated with

minority groups, such as apathy towards education and perceptions of criminality (McGee,

2016). Many African American students may not have the resources to support their educational

endeavors, especially if they are first generation college students and have family members,

peers or community members that do not have positive attitudes towards STEM and lack

understanding about the demands of the profession (Jacobs et al, 1998; Peteet et al, 2015).

Conversely, parents and trusted adults play a significant role in the chosen profession, pursuit

and retention of minority students (Peralta et al, 2013; Jacobs 1998). Pre-college programming

and bridge programs tailored to African American students in STEM have shown that

participants in these programs are twice as likely to persist and succeed in STEM degree

programs and about five times more likely to pursue graduate education in STEM at the doctoral

level. During these programs, students are given the resources to begin to learn how to

successfully integrate both academically and socially into the collegiate setting, building their

STEM identities through meeting and interacting with future professors and peers that may have

similar career goals, allowing them to effectively create and integrate into a supportive

community system (Stolle-McAllister, 2011; Mondisa & McComb, 2015). It is imperative that

STEM and agricultural professionals acknowledge the importance of social networks in the

development of students and to endeavor to facilitate personal and professional relationships

with members of the STEM and agricultural communities. It is also important to note that the

increased interaction between minorities and non-minorities within STEM and agricultural

groups can facilitate opportunities for group members in each group to learn from one another, creating a reciprocal relationship and reaffirming STEM identity.

For many years, STEM recruitment and retention initiatives have worked to understand the blockages and leaks within the "STEM pipeline." The STEM pipeline refers to the trajectory of those entering into STEM and proceeding to STEM degree completion and employment, while the leaky pipeline metaphor refers to the loss of STEM talent at various points within the STEM trajectory. However, this metaphor, offers an unrealistic depiction of those entering and exiting STEM careers. A 2014 report by the National Science Board, a branch of the National Science Foundation (NSF), reclassified the "STEM pipeline" using examples of STEM pathways, showing that oftentimes, students and job seekers did not take a direct path into a STEM career, but instead utilized a variety of approaches and experiences that catalyzed them into STEM careers (National Science Board, 2014). High school students that take and complete rigorous coursework in STEM related fields are more likely to pursue STEM degrees within a university setting despite race or gender, however in most cases, female and/or ethnic minority students are not taking the courses at the same rates as non-minority students. High achievement in physics and calculus were often indicative of a successful future in a STEM major, particularly as it relates to engineering and math (Yoon & Strobel, 2017). Because CTE coursework has often been excluded from membership as a STEM field, there is little data showing the number of CTE trained professionals that enter into STEM careers.

A study by Zhang and Barnett (2014), detailed how high school students envisioned STEM career pathways. During this study, they found that African American students were more likely to pursue athletic professions as viable career options and that the STEM interests of female students declined as they matriculated through school (Zhang & Barnett, 2014). Within

agriculture, a STEM-related fields, many students are often discouraged from pursuing agricultural careers based on the perceptions associated with traditional farming. Modern agriculture has also been depicted in a negative light with increasing spotlights showing industrial or factory farming models with ill treatment of livestock. In addition, the historical association between agriculture and slavery within the United States is a significant detractor from agriculture for many minority students, particularly African American students and Hispanic or Latino students who may associate agriculture with migrant work (Beyl et al, 2016). Jacobs, Finken, Griffin, and Wright (1998) found that parental knowledge and awareness about STEM careers influenced the pursuit of their children to seek out STEM related career options, finding that parental awareness and attitudes towards science was linked to student attitudes and interest in science as well as the fact that locations possibly compounded issues with career awareness related to STEM (Finken et al, 1998).

Current statistics indicate that STEM and agriculture careers are fields dominated by Caucasian males, which makes up 71% of the STEM workforce (Landivar, 2013). In fact, only approximately 6% of the STEM workforce identifies as African American and 7% identify as Hispanic and/or Latino although these groups make up approximately 12% and 16% of the entire United States population (Landivar, 2013). Of this group, only 4% of the African American population within STEM identified as male. African American students are both underrepresented in STEM and more unlikely to complete a degree in STEM (Strayhorn, 2015). These statistics further break down to show that the distribution of STEM degrees to black males are 41% agricultural sciences, 30% biological sciences and 42% physical sciences (Gasman et al, 2017). In fact, current statistics indicate that black men are more likely to go to jail than to attend college (Strayhorn, 2015). In fact, according to Lee and Ransom (2011), most men of color end

up in one of the following pathways upon the completion of high school with only 30.3% or

African American and 19.8% of Latinx peoples ages 25-34 attaining an associate degree or

higher in 2008.

- Enrollment in postsecondary vocational education

- Enlistment in the U.S. Armed Forces

- Basic employment

- Unemployment

- Incarceration

- Death

(Lee & Ransom, 2011)

Flowers and Banda (2015) found that educational attainment for African American men

and Latino men was lower in number than that of their peers and that they demonstrate lower

success rates in STEM disciplines in postsecondary education. It has been postulated that

culturally diverse students such as African Americans are often viewed through the deficit

perspective and with through a perspective of white masculinity, failing to recognize the

differences experienced by members of non-dominant groups. In fact, literature about the

development experiences of gifted men of color within education are limited (Flowers & Banda,

2015). Research has shown that African American men are not attending and completing college

degrees at the same rate as their counterparts. Among African Americans, two women obtain

degrees per every African American man (Journal of Blacks in Higher Education, 2002). The

experiences of black men are often times less favorable to the pursuit of education than those

faced by African American women, accounting for some of the variation amongst degree

attainment between the two, including many negative educational experiences that impacted

minority males at a greater rate than minority females. In addition, the "weed-out" culture of many STEM courses is perceived by students to be a barrier to student success (Hall & Rowan, 2000; Gasman, 2017).

There is limited literature available about African American men that enter and persist in STEM at predominately white institutions. However, historically black colleges/universities have had a more significant impact on the recruitment and retention of minority males in STEM fields such as mathematics and engineering (Jett, 2011; Gasman et al, 2017). Marginalized groups such as African American males are likely to be excluded from advanced STEM courses and do not have access to well-trained STEM instructors, leaving them at a significant disadvantage for the pursuit of STEM careers (Mark, 2016). In addition, minority students may often indicate having negative interactions with non-minority faculty or peers who are deficient in cultural competencies and lack peers with common backgrounds (Litzler et al, 2014; Diefenbeck et al, 2016). Hinnant-Crawford (2016) found education equity and equality to be one of the most pressing civil rights issues of today with quality STEM access being typically reserved for more privileged groups while Martinez (2012) acknowledged a report from the National Academy of Sciences that found that many learning institutions do not prepare minority students in STEM as well as they prepare Asian and Caucasian students. STEM education has often been perceived to be culture-neutral field however, there is a significant disconnect between school-culture and student culture. There are also issues surrounding the disproportionality of student discipline within marginalized groups, leaving one to infer that STEM education is also influenced by the prevailing culture (Hinnant-Crawford, 2016; Ferguson, 2001). Generally, low achievement in math and science courses in high school often require students that are still considering STEM careers to take remedial courses upon entrance into the college or university setting. These

courses are often non-credit bearing, increasing the time for matriculation to graduation, absorbing instructor resources and disheartening students. In addition, it can be expensive for smaller colleges and universities to offer STEM research experiences that fit within the student schedule, further limiting STEM exposure (Martinez, 2012). Given the barriers created by perceptions of race, socio-economic status and educational inequities, African American men must interpret these facts, use introspection to determine how he fits into his field despite these facts and plan his interactions to navigate the environment.

Preferred Problem-Solving Styles

Increased diversity initiatives in businesses, organizations and education are bringing together individuals from various groups with differing life and learning experiences. Within the workforce, a lack of diversity exposure may negatively impact or influence the ways in which members of different groups interact or cooperate with one another regardless of ethnicity. This can present issues surrounding diversity and overcoming cultural differences leaving one to negotiate how to respond to the issues before addressing the original problem. According to adaption-innovation theory, each person has a preferred problem-solving style that they utilize when working in teams and/or responding to issues that they may be faced with (Kirton, 2011; Bush et al., 2017).

Coping Outside of Preferred Problem-Solving Style

Samuel and Kohun (2010) conducted a study about the perceived behaviors of students by faculty members utilizing Kirton's A-I theory as a perspective. In their study, it was found that students exhibiting coping behaviors could be identified through a behavioral shift, however

this behavioral shift is not always noticeable, dependent upon how much or how little coping is occurring. While all people experience coping behaviors, coping outside of ones preferred problem solving style for extended periods may cause cognitive distress and become continually more difficult. Extended periods of coping have the possibility to manifest as tension causing conflict within relationships or between people with differing problem-solving styles. Preferred problem-solving style and coping also have a relationship with motivation, with motivation acting as a factor determining how long one will continue to work outside of their preferred problem-solving style (Kirton, 2003; Samuel & Kohun, 2010). Within the context of STEM education, African American students are thrust into an environment that is often much different from their home environments. As these students assimilate into the STEM culture and develop STEM identities that may contradict other identities that they hold, it is inherent that coping must occur and that behavior modification take place, for as long as motive is available, in order to assume their new STEM identities.
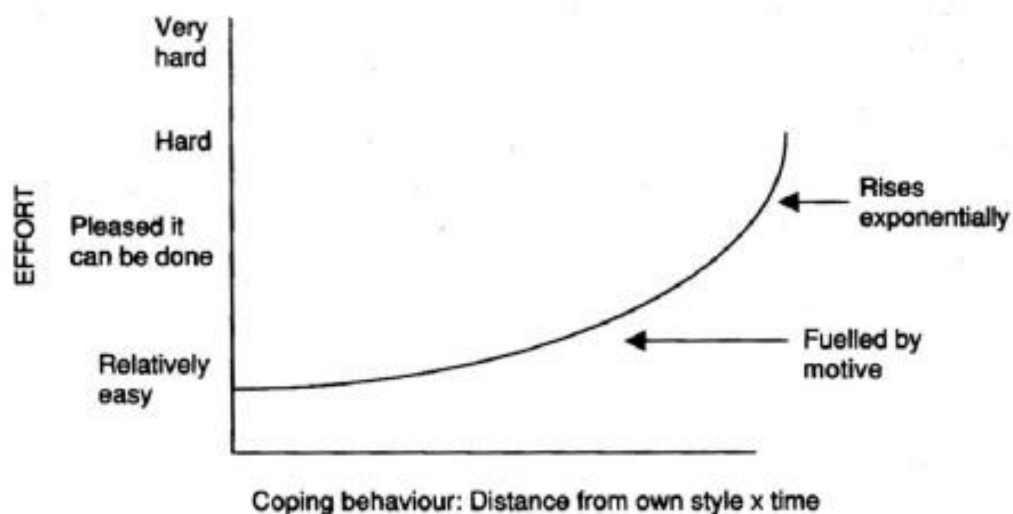
Figure 4: Coping Behavior Schema (Kirton, 2003)

Academic Motivation and Environment

Motivation is a concept that is inherently tied to Self-Determination Theory (SDT). This theory posits that one's internal or intrinsic motivation propels them to work through a task even when met with difficulty, but that one that is extrinsically or externally motivated may discontinue a task if externally rewarded. Before the discovery of SDT, many believed that behavioral rewards were the best way to encourage people to perform tasks and to reinforce desired behaviors. This theory is designed to stand as a frame by which ongoing studies can be built. There are three concepts or psychological needs within this theory that can undermine or enhance motivation: autonomy, competence and relatedness (O'Hara, 2017). The academic environment may also have varying impacts on academic motivation.

Academic Motivation. Within the study of motivation, there are several constructs including: self-efficacy, self-regulation, and achievement motivation (DeCuir-Gunby & Schutz, 2017 p. 4). For purposes of this research, the focus will primarily revolve around academic motivation as it relates to self-determination theory. Academic motivation in particular has been found to be a major predictor of academic success with students exhibiting higher academic motivation engaging more with course materials, more readily persisting through academic challenges, heightened eagerness to perform duties and deeper academic self-concept or identity (Karatas & Erden, 2017). Academic motivation can be denoted as either intrinsic motivation, meaning motivation that comes from within self or self-motivation or extrinsic motivation, which refers to forces external to self that motivate one towards goal completion, while amotivation refers to a lack of motivation (Anderson et al, 2018). Levels of amotivation measured within this study may

provide insight into shifting perceptions about one's success or lack thereof in STEM disciplines based upon individual expriences.

Environment. Oluwatayo, Aderonmu, Aderonmu, Aduwo, and Peter (2016) defined the learning or academic environment as one inclusive of both teaching, the support of teaching and motivational constructs, such as learning enthusiasm which is student dependent. This environment, along with student motivation is also impacted by the structure of the classroom or workplace (Oluwatayo et al., 2016). Students in STEM degree programs often have lower completion success rates those pursuing non-STEM degrees, despite data indicating that as a whole, students deciding to pursue STEM degree programs are often more academically prepared for college than students in non-STEM fields (King, 2015). Data from this study indicate that practices within STEM fields such as grading on a curve impact the support that a student receives from peers and that students receiving lower grades feel as if they do not belong in the field (King, 2015). Kendricks and Arment (2011) identified and implemented six interventions from K-12 educational strategies for use in undergraduate degree programs to create a successful and supportive learning environment for minority students. Three of the interventions included supportive family environment to aid students in building academic confidence and self-esteem along, academic rigor which was more likely to increase with environmental changes and dynamic classroom strategies, including positive reinforcement, social skill development, mentorship and role modeling. It was found in this study that students often preferred a more nurturing learning environment (Kendricks & Arment, 2011). These studies indicate that student perceptions of a learning environments are not only physical in nature but are also impacted by the structural supports within the environment including human

capital and human interactions. Similarly, Chapman-Hilliard, Beasely, McClain, Cokley, Nioplias and Taylro (2016) found that engaging minority students with culturally relevant learning opportunities, increased perceptions of student interpersonal safety, increased student cultural awareness and increased student academic growth through heightened intrinsic motivation (Chapman-Hilliard et al., 2016). Drawing upon this study, it can be inferred that an increase in culturally relevant pedagogy would produce similar results for African American men pursuing degrees in STEM.

Belongingness

Belongingness is a concept with links to both cognitive and emotional well-being as well as one that is reliant upon one's social connections and interactions. Within the concept of education, belongingness refers to one's sense of community and membership within a community of scholars or other learners. Within these communities the connections that one makes may help to sustain a sense of belonging, inclusion or fit which have been found to have a significant relationship with academic achievement, involvement, persistence and adjustment. Within the STEM field, those that have a greater sense of belonging tend to be more likely to persist in the field (Wilson et al; 2015). While the STEM field may present challenges for persons from any background, students from ethnically diverse background may face challenges related to the racial climate impact both belongingness and individual successes. The decision for students to pursue a particular degree program is related to their beliefs about their effectiveness in the subject matter or task and how much they may have to give up in order to achieve degree completion. Strayhorn, Lo, Travers and Tillman-Kelly (2015) found that underrepresented minorities often left STEM majors due to a lack of a sense of belonging or understanding about

the ways in which STEM could be applied to practical problem solving. Additionally, negative racialized experiences have impacted minority student sense of belongingness both academically and socially, impacting their desires to persist in the degree program. Similarly, the STEM curriculum may not always connect with student goals or incorporate cultural relevancy, further alienating minority students (Strayhorn et al., 2015; Garibay, 2018).

Summary

This chapter provided an overview of the salient theories and concepts that provide the foundation for this study which includes Bandura's social cognitive theory, Kirton's adaption-innovation theory, the organismic socio-behavioral perspective, nigrescense and critical race theory which is the lens through which the development of a science identity will be explored. The conceptual framework for this study is a derivative of the cognitive function schema and the organismic socio-behavioral perspective which explain the cognitive functions that take place in problem solving and factors impacting motivation respectively. This conceptual model may provide insight into how motivation and problem-solving preference influence the development of a science identity among African American men. The overall review of literature described a number of issues related to the entrance and persistence of African American men in the fields of STEM and agriculture; however, there were no studies that focused the influence of cognitive style on one's science identity development. This study will give voice to this population by contributing to emerging research on science identity development utilizing a cognitive lens.

Chapter 3

Methodology

The purpose of this study was to describe participant demographics, interpret experiences within the degree program in accordance with problem solving style and to analyze the feelings of belonginess based upon the description of demonstrated behaviors of African American men while in the pursuit of the STEM or agricultural degree. In an effort to deconstruct these layers, the following research questions were utilized to guide this research study:

1. How does one's expressed behaviors compare to one's problem-solving style, academic motivation and subscription to black identity?

2. Are African American males feeling a sense of belonging within STEM degree programs?

3. How are coping behaviors being evidenced among African American men within STEM degree programs?

Utilizing information gathered from a literature review on the STEM identity development of African American males, it has been found that STEM identity development is a complex process consistent of many layers. These research questions were addressed utilizing a descriptive research design. This qualitative research design provides a critical lens of analysis to produce data that is more representative and inclusive of the experiences of those within the participant group (Johnson et al, 2007).

Ontology & Epistemology

This study methodology has been influenced by social constructivism and interpretivism. The social constructivist ontology posits that the stability of social institutions is based upon the

incidences that take place on an individual level, which then become objectified and taken for granted as reality, specifically focusing on the interdependence of social processes and individual processes that interact to construct knowledge (Hill-Collins, 2000). People that become associated with these social institutions or groups are expected to conform to the standards that fit within the ideation of the groups' shared realities (Lynch, 2016; Palincsar, 1998). The term "social constructivism" was first coined by Berger and Luckmann in 1967 when it was presented as a theory contrasting the psychological and cognitive orientation of constructivism, instead choosing to denote the importance of social reality and the processes that were involved in its construction (Knoblach & Wilke, 2016). Social constructivism draws upon the scholarship of Vygotsky, Dewey and Piaget, some of the forefathers of constructivist thought. I have chosen to adopt the definition of social constructivism put forth by Beck and Kosnick (2006) which seeks to engage all members of a learning community by creating a safe space to express ideas and opinions while remaining open-minded about the thoughts and opinions of others, fully engaging the student. The social constructivist approach is holistic in nature, seeking to reconcile the thoughts, emotions and actions of the learner and can be used to bridge barriers in learning and communication between students in both minority and majority groups (Beck & Kosnick, 2006 pp. 7-8). There are five basic tenets of social constructivism as listed by Beck and Kosnick (2006):

- Knowledge is constructed by learners - Learning occurs when one can link new materials to an existing concept and determine its usefulness.
- Knowledge is experience-based - New concepts or materials are interpreted and reinterpreted based upon ones' experiences.

- Learning is social - Communities can help or hinder the learning processes based upon the supports or lack thereof provide to learners.

- All aspects of a person are connected - Learning is holistic and dependent upon attitudes, beliefs, values etc.

- Learning communities should be inclusive and equitable - The development of inclusive learning environments provide opportunities for relationship development and supportive collective group mentalities.

(Beck & Kosnick, 2006 pp. 9-11)

The interpretivist epistemology at its crux requires constructivism as one must process how meanings are constructed, determine the role of language and the roles of actors within the space. Therefore, construction must take place before interpretation can occur (Denzin & Lincoln, 1998). The symbolic interactionist framework is a particular persuasion of interpretivism that will be utilized in this study. The history of symbolic interactionism begins with the scholarship of George Herbert Mead who developed an approach that dictated that humans adapt and survive in their environment by sharing common symbols (White, Klein and Martin, 2015 pp. 74). Within this persuasion, it assumes that people interact with the world and persons or objects within the world based on the meanings that they ascribe to them based on previous social interactions, communication is symbolic with meanings being construed from both language and body language and/or symbols and that these meanings are established, modified or changed based upon interpretive processes (Denzin & Lincoln, 1998; White, Klein and Martin, 2015 pp. 73; Carter & Fuller, 2016). The assumptions of symbolic interactionism, specifically as they relate to meaning making, provide the backdrop for the use of symbolic interactionism to view the negotiation of professional identity and the role of student-faculty

relationships among African American males whom, as a group, have been maligned with negative stereotypes that are not indicative of positive professional attributes. The breadth of symbolic interactionism includes of a number of theories and perspectives related to concepts associated with education, psychology and human development. Some of these theories and perspectives include factors such as attitudes, culture, self & identity, impression management, emotions, attribution, labeling, cognitive dissonance and balance theory (Scott, 2015). These theoretical approaches create a space for better communication between learners and facilitators by engaging them with approaches that generate connections between the teacher, learner and the subject matter by allowing them to better identify with it in addition to reaffirming the learner through the acknowledgement of individual strengths that are pertinent to the creation of solutions to the problems of today and the future. The figure below displays some of the factors associated with the symbolic interactionist lens.
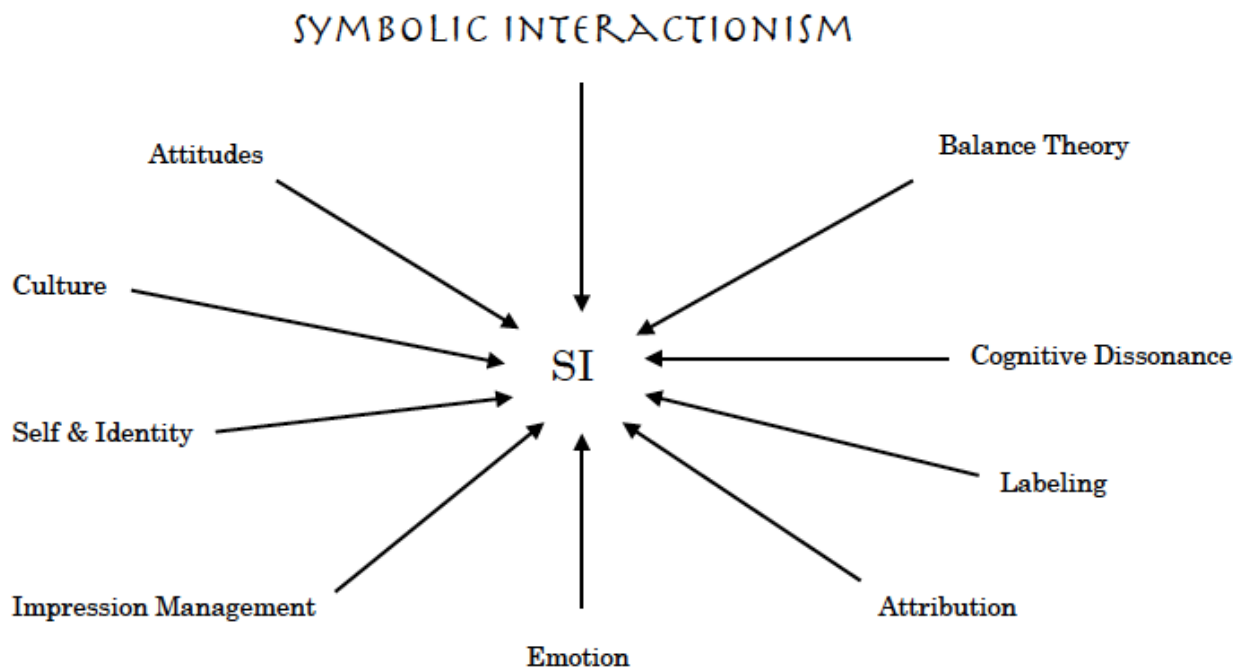
Figure 5: Symbolic Interactionism (Texas Tech University)

Critiques of Social Constructivism & Interpretivism

While there are many notable uses for the social constructivist paradigm, this ontology is not without scrutiny. One of the most prominent critiques of this paradigm is the lack of specificity within its interpretation by Berger and Luckmann (1966). This lack of specificity has allowed multiple interpretations to evolve from the basic concept of social constructivism which has led to some confusion and misconceptions regarding it (Knoblack & Wilke, 2016; Beck & Kosnick, 2006). Khalifa (2010) offered an additional critique of social constructivism by beginning with the dissection of constructivism, the "parent" theory of social constructivism into strong and weak constructivism. A strong constructivist standpoint holds the view that the certainty of facts is based upon social conditions at the time of its establishment as fact. While a weak constructivist standpoint holds the view that if scientific principles were different, one would not have the same thoughts regarding a subject area or that the thoughts surrounding it would be trivial (Khalifa, 2010). This research will subscribe to a strong social constructivist paradigm, positing that all knowledge is socially constructed, based upon a reality that is dependent upon language and social habits. This positionality and ontology will be beneficial to exploring the perceptions experiences of African Americans whom have historically been negatively racialized and subjected to various injustices based upon that racialization.

The study of STEM career and education policies and practices may greatly benefit from the usage of the social constructivism and interpretivism paradigms as the push for diversity within the field increases. Feelings of social isolation and inferiority may be compounded by structural barriers such as poverty, lack of mentorship, and unequal access to quality education experienced by minority groups may be mitigated with the increase of social constructivist and

interpretivist practices (Vincent, Henry & Anderson, 2012; Vega, Moore & Miranda, 2015). The social constructivism and interpretivism paradigms allow for the (re)interpretation of characteristics, practices and ideologies long ascribed to the African American population. The addition of the African American voice to the telling and description of their realities and experiences will provide a better understanding of the issues faced by this population and interrogate solutions to these issues.

Methodological Approaches to the Study of African American Men in STEM and Agriculture

African Americans males are a group that has been marginalized throughout history and is still considered a marginalized group today. Given the historical context impacting the advancement of African Americans today and the researcher's positionality as an African American woman, it is important to select a methodology that not only addresses the social injustices experienced by the group, but one that also allows the researcher to check assumptions due to positionality and close proximity to members of the group. This has influenced the researcher's belief in a social constructivist ontology and interpretivist epistemology with a soft positivist lens.

Methodologies

This study will utilize a qualitative study design that is informed by descriptive quantitative data based on psychometric inventories. This practice, will allow for qualitative and quantitative data to be collected and analyzed to inform one another (Decuir-Gunby & Schutz, 2017).

Phenomenology

Phenomenology as a methodological approach can be advantageous for use within marginalized populations or maligned groups because it provides an in depth analysis or examination of a specific issue from the view point of those experiencing it. Phenomenological studies are somewhat interdisciplinary in nature as they allow the usage of other methodological techniques if they will help to better illustrate the phenomenon, however, interviews and focus groups are the most commonly used methods (Singh, 2015). There are two phenomenological traditions, descriptive and interpretive, stemming from the works for Husserl and Heidegger respectfully (Smith, 2016).

Descriptive phenomenology follows the tradition of Husserl, seeking to describe everyday experiences, setting aside preconceived notions through the use of bracketing (Reiners, 2012). Bracketing refers to describing an event without interpretation of it. Singh (2015) described the usage of bracing and bracketing as well as the maintenance of a reflexive journal to document researcher presuppositions and challenges as well as how they may change before and at the completion of data collection (Singh, 2013). Through the usage of bracing and bracketing, this branch of phenomenology seeks to examine a phenomenon with impartiality or neutrality. Researchers subscribing to this approach use language and exemplar events to describe the phenomenon taking place instead of interpreting them (Reiners, 2012; Giorgi, 2012). This method of phenomenological research can be beneficial when investigating phenomenon that have not been well documented or researched in order to establish a baseline to describe the issue. This method seems to be a necessary first step into any sociological research study because

understanding what the phenomenon is, is essential information that can be built upon in future research. Its impartiality also better checks for researcher biases.

Of the two schools of thought related to phenomenology, this research subscribes to interpretive phenomenology which more closely aligns with the works of Heidegger. This branch of phenomenology identifies an experience that can be analyzed or described while people are undergoing or living through the experience (Ivey, 2013). Conroy (2003) described Heidegger's concept of interpretive phenomenology as a hermeneutic spiral, where people build upon each other's various interpretations of an event or experience over time, suggesting the development of shared understandings and the creation of trust to draw out hidden narratives. This process involves an ongoing interpretation, reflection and reinterpretation as information is shared and understandings change (Conroy, 2003). Within interpretive phenomenology, the researcher also acts as part of the research by engaging with research participants, essentially becoming somewhat immersed in the experience (Tuohy et al, 2013; Inyama et al, 2015). This phenomenological tradition does not require bracketing because the hermeneutical processes involved in it indicate prior understanding with personal experience being an intrinsic part of phenomenological research, bringing imagination to research and describing an experience that may have been otherwise obscure or understood (Reiners, 2012). This branch of phenomenological analysis offers many benefits for usage within marginalized groups. The ongoing (re)interpretation of data allows both the researcher and the research subject to be continually conscious of their own biases and subjectivities. This can help to better understand the meaning associated with experience and the processes involved with how one arrives to the definition of that meaning. This type of research methodology would work well within populations where phenomenon have been documented but mechanisms leading to the

phenomenon have not been described. However, the close interaction between researchers and participants does leave room for biases that will color the research.

Design of Study

This study will use a qualitative research design to focus on the ways in which students navigate the processes of STEM identity development and problem solving within STEM and agriculturally related fields. Examples of STEM include science, technology, engineering and math while agriculturally related fields may consist of dairy science, agricultural engineering, biotechnology and more. Each of these agricultural fields are inclusive of STEM. The decision to utilize a qualitative design is based upon the desire to capture unique data that can describe the complexities of experiences of members within the study population.

This study will also collect quantitative data to provide descriptive information to inform the qualitative data. This process will allow richer description and meaning making between data points and participant descriptions. Quantitative data alone has often been biased towards marginalized groups such as African Americans, reporting statistics that fail to acknowledge circumstances that may impact association with certain factors. By utilizing quantitative data to inform qualitative results, a more inclusive data set is presented, acknowledging that qualitative factors that may influence quantitative data points, providing the impetus for collecting descriptive quantitative data throughout this qualitative research process (DeCuir-Gunby & Schutz, 2017; Creswell & Plano-Clark, 2008).

Within this particular study, quantitative descriptive data will better allow the researcher to compare qualitative data describing black identity, problem solving preference and academic motivation with participant narratives that may further explain responses. Participant narratives

may extract more information than what would be available by relying solely upon qualitative measures.

Analytic Induction

In an effort to draw connections and to better interpret student perception and experience through a symbolic interactionist lens, this study used the process of analytic induction. Analytic induction or explanation building is a process in qualitative research that allows one to build and confirm links between events, processes and more. The process allows one to develop a hypothesis and determine hypothesis confirmation case by case to determine if the case deviates from the hypothesis (Fontana, 2015). This process was utilized in an effort to deconstruct the relationship between one's problem solving style, academic motivation and subscription to black identity, hypothesizing that one's behaviors are indicative of one's problem-solving style and that behaviors varying from style indicate coping fueled by motivation.

Sampling and Recruitment

Context: The majority of participants in this study attended a large land-grant university which is also designated predominately white institutions (PWI) established by the 1862 Morrill Land Grant Act, allowing for the creation of universities with the mission of educating the public. A PWI is defined as a university that has a student population that is over 50% white and that historically excluded African Americans and other persons of color from admission (DeCuir-Gunby & Schutz, 2017). Additional participants hailed from one smaller liberal arts college and a historically black university. This context is salient for our study because African Americans are underrepresented within the larger realm of STEM and agriculture as well as

within the chosen university settings. In an effort to increase participation, the study was extended to any willing participants who self-identified as an African American male enrolled in STEM and/or agricultural degree programs throughout the United States.

Participants: The target population for this study consists of African American males in STEM and agriculturally related degree programs. The survey recruited 20 undergraduate students to complete part one of the study, the completion of an online survey. Participants were allowed to self-select to continue participation in the next phases of the research. Approximately 10 students ($N = 10$) male students were recruited from the survey data to participate in the second phase of the study, a qualitative interview session. Participants electing to continue with the study indicated a willingness to complete the KAI and move into the interview session. For purposes of this study, STEM and agricultural degree seekers were defined as students actively enrolled in degree programs housed with the College of Agriculture & Life Sciences, College of Engineering, College of Natural Resources and Environment, College of Science, the College of Veterinary Medicine or similar designations at their individual universities.

Data Collection

Instrumentation: The Multidimensional Inventory of Black Identity and the Academic Motivation Scale – College Version (AMS-C28) were used to collect broad information about the motivations, perceptions, experiences, and demographic information of participants in this study. Participants that agreed to continue were then invited to complete Kirton's Adaption Innovation Inventory.

Multidimensional Inventory of Black Identity (MIBI)

The Multidimensional Inventory of Black Identity (MIBI) is a 56-item inventory that measures three stable dimensions of African American racial identity (1) Centrality (2) Ideology; and (3) Regard (Sellers et al; 1997). Centrality refers to the extent that one views race as a core part of one's self-concept. Ideology refers to the way one believes members of the race should act and interact with others in society, and Regard refers to one's judgement, both affective and evaluative on his or her race. The Multidimensional Inventory of Black Identity was utilized to determine the participant's identification with black racial identity. This data was used in determining if one's expressed racial identity had any bearings on one's motivation problem solving style or perceptions about experiences within the STEM or agricultural degree program. The Kaiser-Meyer-Olkin test was utilized to evaluate the appropriateness of factor analysis of the concepts. For this measure, a reliability alpha value of .60 is acceptable.

- o Centrality – The KMO for this construct = .86
- o Regard – The KMO for this construct = .61
- o Ideology – The KMO for this construct = .83

Academic Motivation Scale – College Version (AMS-C28)

The Academic Motivation Scale – College Version instrument is an assessment designed to determine intrinsic and extrinsic motivation in addition to amotivation through seven subscales. This instrument is grounded in self-determination theory (Vallerand et al, 1992). This instrument was utilized to collect data related to student motivation to pursue and persist their academic program. Vallerand et al (1992) conducted a confirmatory factor analysis on the seven-factor model of the instrument and found that the seven-factor structure to be stable. Additionally, the reliability of the Academic Motivation Scale was tested and found

good internal consistency (mean alpha value = .81) and temporal stability within a period of one month (mean test-retest correlation =.79). Goodness of fit index = .89, Adjusted Goodness of Fit index = .87 and Normed Fit Index = .89 (Vallerand et al, 1992).

- o Intrinsic Motivation – this specific construct measures one's internal or self-motivation. Within the model, this construct can be divided into three sub-constructs related to knowledge, accomplishment and stimulation. Within each of the following the internal consistency ranged between .80 and .90 in numerous samples.

- o Extrinsic Motivation – this construct measured one's externally motivating factors, internal consistency ranged between .62 and .78 in three different samples.

- o Amotivation – this construct measured one's apathy or lack of motivation. Internal consistency ranged from .83 and .91

Kirton's *Adaption-Innovation (KAI) Inventory*

Kirton's Adaption Innovation (A-I) theory provides insight into how people solve problems and manage diversity and change regardless of race and ethnicity, the theory postulates that increased diversity among teams is more difficult to manage but that it is also required in order to solve more complex problems. Kirton's Adaption-Innovation (KAI) Inventory measures the preferred problem-solving style of the participant on a continuum that measures adaption and innovation on a scale between 32 and 160. On this continuum, innovators fall on the higher end of the scale and adaptors falling on the lower end of the scale, which is centered on a mean of 95 points. The KAI Inventory is a 2 assessment-item inventory using a Likert-type formatted scale. The internal reliability of the internal model is .88 and also accounted for 78% of internal variance (Kirton, 2013). In replicated studies, the internal reliability coefficient has consistently reached .88. The target for KAI validity was set at .7,

with factor trait reliability for each of the subscales grouped between .76 and .84 (Kirton, 2017). Face validity has shown that KAI is short but highly reliable, easy to administer and describe, easy to get responded cooperation and easy to score manually and with accuracy (Kirton, 2017).

The KAI has three sub-scores for group/norm conformity, sufficiency of originality and efficiency.

- o Sufficiency of originality (SO) – Range 13 to 65; Idea generation; describes differences in the ways in which people prefer generating new ideas or notions. More adaptive individuals generally produce fewer novel ideas than innovators, but those ideas tend to have a higher rate of success. Internal reliabilities for this sub-score ranged between .78 and .84 (Kirton, 2017)

- o Efficiency (E) – Range 7 to 35; Methodology; describes style differences in problem solving among people. More adaptive individuals generally define problems more carefully and search more methodically while more innovative individuals may pay less attention to detail and thoroughness. Internal reliabilities for this sub-score ranged between .73 and .82 (Kirton, 2017).

- o Rule/group conformity (R) – Range 12 to 60; Management of Structure; describes differences in the style of management structure. More adaptive individuals are more likely to work within the rules or structure to solve problems whereas more innovative individuals are more likely to problem solve by bending or breaking rules. Internal reliabilities for this sub-score ranged from .74 - .87 (Kirton, 2017).

Interview: In order to accommodate each participant and to gain a phenomenological understanding of experiences, this study was conducted using interviews featuring open-ended

questions. The open-ended questions allowed participants to describe their individual experiences with STEM identity development and problem solving.

Procedures: Participants were recruited via email listservs, word of mouth and social media. The email and social media announcements informed potential participants of the purpose of the study and invited their completion of the Multi-dimensional Model of Black Identity and Academic Motivation Survey via Qualtrics. These instruments were combined and housed within the online Qualtrics portal to increase ease of navigability for participants. Upon the completion of these instruments study participants were asked to indicate their willingness to be contacted for participation in an interview. Participants for the second part of the study were selected based on pre-established criteria such as gender identification and ethnicity and willingness to participate. The participants were contacted via email with for consent and instructions to complete the KAI, and to schedule a follow-up interview. One-on-one semi-structured interviews were conducted between the researcher and the research participant. Each interviewee was asked to respond to a common set of open-ended questions found in Appendix G. Each interview was audio recorded to better capture the contents of the interview conversations. Responses were coded using constant comparative analysis (Kolb, 2012; Charmaz, 2014), and interpreted alongside demographic data.

Analysis

Participants in this study were invited to complete demographic data including the completion of the MIBI & AMS surveys. Upon completion of these instruments, participants were invited to complete the KAI inventory and to participate in an interview session. Results from the MIBI, AMS and KAI instruments were utilized to provide descriptive data to support

qualitative data emerging from the interviews. Data from each interview were analyzed utilizing the process of analytic induction, allowing the interpretation and reinterpretation of data to determine if individual cases supported the original hypothesis and to determine connections between events (Goldenberg, 1993). Each of the objectives below frame the research questions and the data analysis processes used to respond to each question.

Objective #1: How does one's expressed behaviors compare to one's problem-*solving style, academic motivation and subscription to black identity*

Results from the KAI, MIBI and AMS instruments were analyzed and compared to behaviors described within the interview process. Results were analyzed to determine if coping was occurring due to cultural differences, differences in problem solving style or differences in expertise.

Objective #2: Explore the sense of belonging experienced by African American males in STEM degree programs

Qualitative data from one-on-one interviews were used to determine participant perceptions of positive school and student-culture versus perceptions of negative school and/or student-culture. Responses to questions related to this objective were coded for themes and utilized to better describe the quantitative data and expound upon the themes found within the qualitative data. Constant comparative analysis was utilized conduct an iterative coding process generating codes and grouping them into emergent themes. Two themes emerged from this objective. Member-checking was utilized to support conclusions.

Objective #3: Explore the relationship between student success and coping/behavior modifications

Qualitative data from the focus groups were coded to determine emergent themes of coping, success and behavior modification. These themes were compared with respondent data to the Multidimensional Model of Black Identity and Academic Motivation Scale surveys. Responses to questions related to this objective were coded for themes utilizing constant comparative analysis to conduct and iterative coding process, generating codes and grouping them into emergent theme. This process yielded two themes for this objective. This data was utilized to better describe the quantitative data and expound upon the themes found within the qualitative data. Member-checking was utilized to support conclusions.

Assumptions: For this study, post-positivist and constructivist assumptions were considered. Some assumptions of this study include:

- African American males in STEM and agricultural degree programs are exhibiting coping behaviors.
- African American students experience a disconnect between school-culture and African American-culture.
- African American student sense of belonging is influenced by perceptions of race.
- Participants with higher motivation scores cope for longer durations of time.

Reflexivity Statement

As aforementioned, this study embraces a constructivist and interpretivist ontology and epistemology to which the researcher subscribes, acknowledging the ongoing construction and (re)interpretation of social realities grounded in one's lived experience. The researcher identifies as an African American female raised in a two-parent household in a southern rural community

alongside close-knit extended family who also identify as African American. The area from which the researcher hails is one that has significant ties to white supremacist groups and ideologies both presently and historically, which may impact the researcher's interpretation and views of data collected during this study. The researcher also identifies as a first-generation college student. While education was paramount to many within the researcher's home community, the researcher has observed that the K-12 educational experiences of African American males as well as those within programs of higher education has come with many challenges that may hinder success. The researchers' identity as an African American woman with a background in STEM and personal experiences with racism and issues surrounding barriers in education may impact the researcher's interactions with the participants and subsequently impacting the analysis of data and conclusions from the findings.

Summary

Chapter three has provided the study design, methodology and justification for its use in this study. The design represented the best way to examining the STEM-identity development processes and experiences of black who are working to overcome barriers to degree attainment. Overall, this design sought to understand the experiences of African American men seeking to obtain STEM or STEM-related degree programs. Procedures for recruitment, sampling and selection were explained. Similarly, evaluative criteria, the positionality of the researcher and study limitations were explained.

Chapter 4

Analysis and Findings

The purpose of this study was to explore the experiences of African American men in STEM and/or agriculturally related undergraduate degree programs relating to the development of a STEM identity informed by their subscription to black identity, motivation and problem-solving preferences. The goal of this study was to develop a body of data that assists with understanding the psycho-social processes of African American men pursuing STEM or agricultural undergraduate degrees with hopes of developing and informing retention strategies for those entering and persisting in the fields. This body of work addresses the gaps in literature related to African American male achievement in STEM by answering the following research questions:

> **Research Question 1:** How does one's expressed behaviors compare to one's problem-solving style, academic motivation and subscription to black identity?
>
> **Research Question 2:** Are African American males feeling a sense of belonging within STEM degree programs?
>
> **Research Question 3:** How are coping behaviors being evidenced among African American men within STEM degree programs?

Context of Study

In this descriptive case study, the Organismic Socio-behavioral Perspective, grounded in self-determination and motivation theories and Kirton's Adaption-Innovation Theory were utilized to explore the development of STEM identity among African American men pursuing STEM and agriculturally related undergraduate degrees. Participants within this study self-

identified as African American males and were at various stages in pursuit of an undergraduate degree.

This qualitative study explored student experiences, identity subscription and academic motivation informed by qualitative measures utilizing the Multidimensional Inventory of Black Identity, Academic Motivation Surveys and Kirton's Adaption Innovation Inventory. Individual interview discussions were utilized as a method to achieve a broader understanding of participant responses and experiences with meaning making and experiences shaped by identity politics such as double-consciousness during their degree programs.

Demographics & Descriptive Information

This study utilized snowball sampling to recruit African American men in STEM and agricultural degree programs and recruited approximately 19 respondents after removing ineligible or incomplete surveys. Snowball sampling is a method in which the researcher encourages study participants to share the call for research and may have implications on study results producing data on various extremes if participants have similar backgrounds or discuss the study in depth prior to participation (Emerson, 2015). Of the 19 respondents, ten survey respondents elected to continue the research study and complete the KAI instrument and to participate in a one-on-one interview session. All participants in this study self-identified as African American men currently enrolled in a STEM and/or agriculturally related degree program. Participants electing to participate in the interview, provided additional demographic information in addition to completing the KAI.

Data Analysis

Demographic data from the AMS, MIBI and KAI were first analyzed to produce demographic data that was utilized to inform qualitative data results. Data from each instrument analyzed utilizing descriptive statistics and incorporated into each individual participant analysis to respond to research question 1: How does one's expressed behaviors compare to one's problem-solving style, academic motivation, and subscription to black identity?

Academic Motivation Scale Results

The academic motivation scale was utilized as demographic data to quantitatively determine the motivation of each of the participants and to compare it with qualitative data describing the motivation for pursuing a STEM degree. Academic motivation was measured quantitatively using the Academic Motivation Scale – College Version (AMS-28). This instrument utilizes a seven-point Likert scale to measure three constructs related to motivation, extrinsic, intrinsic and amotivation. The table below provides descriptive statistics for the constructs within the AMS survey for ten (*N = 10*) participants that completed the study in its entirety. The charts below provide the descriptive statistics for the complete AMS survey and by constructs within the AMS survey.

Table 1

AMS Descriptive Statistics

Motivation Type	N	Minimum	Maximum	Mean	Std. Deviation
Amotivation	10	1.00	3.50	2.45	.815
Extrinsic	10	4.25	6.42	5.43	.735
Intrinsic	10	4.58	6.75	5.26	.679
Valid N (listwise)	10				

Table 2

AMS Descriptive Statistics via Construct

Motivation Construct	N	Min	Max	Mean	Std. Deviation
Amotivation	10	1.00	3.50	2.45	.815
Intrinsic To Know	10	5.25	7.00	5.88	.604
Intrinsic Accomplishment	10	4.00	6.50	5.38	.810
Intrinsic Stimulation	10	3.00	6.75	4.53	1.06
Extrinsic Identified	10	4.75	6.75	5.80	.654
Extrinsic Introjected	10	4.00	6.25	5.13	.719
Extrinsic External Regulation	10	2.25	6.75	5.38	1.34
Valid N (listwise)	10				

Amotivation – amotivation refers to a lack of motivation. The range of this score fell between 1.00 and 3.50 points with a mean response of 2.45. The range of scoring for this

construct is 1 to 7. This mean score indicates that most these participants ranked low in amotivation, indicating that they are motivated to complete their college education.

Extrinsic motivation refers to the externally motivating factors the impetus for working towards degree completion. Extrinsic motivation may come from a number of sources including media, family and/or peers and more broadly focus on the operationalization of behaviors to as means to get to an end (Vallerand et al, 1992). Data from the respondents ranged between 4.25 and 6.42 with a mean response rate of 5.40 points, indicating that extrinsic motivation is a significant factor in the overall motivation of the respondents. The concept of extrinsic motivation for purposes of this scale is deconstructed into three subscales, consisting of external regulation, introjection and identification. Regulation refers to the outside forces motivating behaviors, while introjection refers to the internalized adoption of external behaviors or beliefs and identification refers to lens through which one views the world based upon attitudes, beliefs or behaviors. The overall extrinsic motivation score is constructed as an average of each of the answers to questions within the extrinsic motivation construct. External regulation is based upon the premises of barriers or constraints and rewards, such as completing a task due to the expectations of another. Introjection refers to one's motivations to complete a task based upon the belief that it is what they should be doing and identification refers to ones' connection with an activity and its' perceived importance (Vallerand et al,1992).

Intrinsic motivation refers to the internally motivating factors that encourage students to work towards degree completion. Data for this construct ranged between 4.58 and 6.75, with a mean response of 5.20 indicating high intrinsic motivation. The concept of intrinsic motivation is broken into three subscales, consisting of intrinsic motivation to know, intrinsic motivation towards accomplishments and intrinsic motivation to experience simulation. The overall score

for intrinsic motivation is an average of each of the three scores. Intrinsic motivation "to know" refers to ones' predilection towards learning goals, exploration and curiosity. Intrinsic motivation "toward accomplishment" is one's desire to achieve, create and accomplish and intrinsic motivation "to experience stimulation" refers to one's engagement in an activity for sensory stimulation or excitement.

Kirton's Adaption-*Innovation Inventory*

The KAI instrument was utilized to quantitatively determine the problem-solving preference of each of the participants to compare it to behaviors described in the interview process. The KAI instrument allows scoring between a range of 32 to 160 with a mean score of 95 points among the general population. Males generally tend to score more innovatively on the KAI instrument with a mean score of 98 points (Kirton, 2011). While all interview participants ($N = 10$) completed the KAI, only seven ($N = 7$) produced interpretable scores and were included as data points. For general purposes, KAI scores are generally interpreted as more adaptive or more innovative with respect to the distance from the mean of 95 points, even though being more adaptive or more innovative depends more on the team members one is working with rather than the comparison to the general population. With respect to the general population, more adaptive individuals have KAI scores less than 95 points and scores higher than 95 points are considered more innovative. In this group, the most adaptive score was 76, and the most innovative individual scored 119 points on the adaption-innovation continuum.

Table 3

KAI Descriptives

KAI Scores	N	Min	Max	Mean	Std. Deviation
Total KAI Score	7	76.00	119.00	100.14	13.52
SO	7	38.00	55.00	45.43	6.40
E	7	13.00	24.00	18.7	4.15
R	7	25.00	45.00	36.14	8.24
Valid N (listwise)	7				

Based upon the mean of this group scoring at 100.14, those scoring less than this mean are identified as more adaptive for this data set, granting a total of 3 adaptors and 4 innovators with interpretable scores for usage within this study. The table and diagram below describe the KAI scores collected during this study and demonstrate a range of the scores.
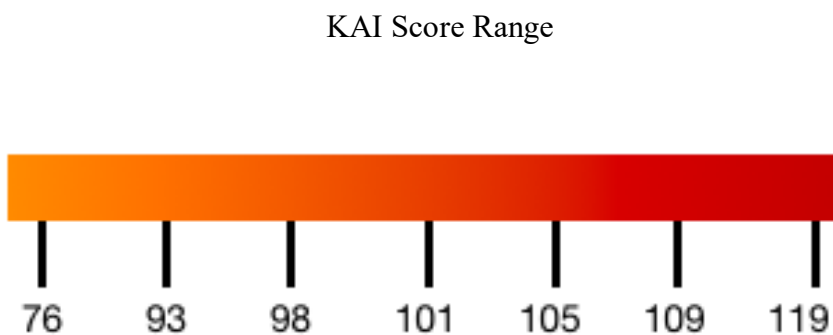
KAI Score Range

Figure 6: KAI Score Range

The research questions for this study have been broken down into two sections with research question one utilizing descriptive information and results of the quantitative measures and instruments utilized within this study to determine evidence of behavioral correlation with characteristics associated with KAI score. Research questions two and three provide information and results of the qualitative data collected during this study via the interview process and also speak towards the descriptive results from some of the quantitative measures.

Multidimensional Inventory of Black Identity

The MIBI instrument was utilized to determine the participant subscription to black identity and the salience of this identity to the interactions taking place within the STEM environment. The MIBI instrument measures one's subscription to factors of black identity by measuring concepts of centrality, ideology and regard. Centrality within this instrument refers to the way one defines themselves in regards to race and its ability to be at the heart of one's self-concept or importance to their being. Ideology refers the way one believes members within one's race should conduct themselves; and regard refers to the way one offers evaluation or judgement on his or her race (Sellars et al; 1997). The MIBI is measured on a seven-point Likert scale. The data below are descriptive data of participant responses (*N = 10*) to the MIBI instrument via construct.

Table 4

MIBI Descriptive Statistics via Sub-Construct

MIBI Sub-Construct	N	Minimum	Maximum	Mean	Std. Deviation
Centrality	10	1.13	2.50	1.68	.383
Private Regard	10	3.50	4.83	4.05	.491
Public Regard	10	0.67	3.00	1.32	.784
Assimilation	10	2.56	6.67	4.92	1.26
Humanist	10	3.44	6.78	5.19	.995
Minority	10	3.33	6.56	4.96	1.05
Nationalist	10	2.56	6.11	3.94	1.00
Valid N (listwise)	10				

Descriptive statistics for private regard, a sub-category of the regard construct within the MIBI indicate a range of 3.50 to 4.83 and a mean of 4.05 indicating high feeling of positivity towards African American's and their membership with the group. Data for public regard resulted in a range of 0.67 to 3.00 with a mean value of 1.32 points, indicating that participants believed that African Americans were viewed in a negative light. Data for assimilation ranged from 2.56 to 6.67 with a mean of 4.92, indicating that many participants believed that more social interaction should take place between those identifying as African American and those identifying as white. The humanist sub-category indicated a range of 3.44 to 6.78 with a mean score of 5.19, indicating that identifying as a human being and the commonalities of being human was of extreme importance. The data collected within the minority sub-category ranged between 3.33 and 6.56 with a mean of 4.96 indicating a importance in viewing the commonalities between African Americans and other oppressed groups. The nationalist sub-

category ranged between 2.56 and 6.11 with a mean score of 3.94 indicating lower feelings of nationalism which is the characterization of the uniqueness of being of African descent.

These results were combined and categorized into the three main constructs of the MIBI, centrality, regard and ideology and descriptive statistics were run to describe general feelings of participants as it relates to each construct. Centrality, the way one defines himself or herself with regard to race, ranged from 1.13 to 2.50 with a mean score of 1.68 indicating that survey participants did not strongly define themselves according to their racial backgrounds. Regard, referring to one's feelings and judgment towards one's race, raged from 2.08 – 3.58 with a mean score of 2.68, indicating that participants overall felt negatively towards their race. Lastly, ideology, referring to one's beliefs and opinions about the way members of one's race should behave, ranged from 4.06 to 5.72 with a mean score of 4.75 indicating that those within the survey group positively viewed the ways that they believed African American's viewed political and socioeconomic issues, intergroup relations towards those with membership in dominant populations. The table below provides descriptive information about the MIBI scores.

Table 5
MIBI Descriptive Statistics

MIBI Constructs	N	Minimum	Maximum	Mean	Std. Deviation
Centrality	10	1.13	2.50	1.68	.383
Regard	10	2.08	3.58	2.68	.463
Ideology	10	4.06	5.72	4.75	.615
Valid N (listwise)	10				

Select Participant Counternarratives

The following is a summary including information about each of the participants in the KAI and interview processes. This brief overview of each participant describes their motivating factors towards degree completion and describes the beginning of their interests in STEM and will be utilized to frame their individual experiences and perceptions impacting their experiences in STEM programs.

Antonio. Antonio is a non-traditional student who manages a full-scale agricultural operation in addition to pursuing an undergraduate degree in Agricultural Education at an HBCU. He has been steadily working towards his degree while navigating a multitude of challenges associated with his business and financial stability of his family. He became interested in STEM as a method to increase profitability for his agricultural operation.

Darius. Darius describes himself as both an immigrant and transfer student in Engineering at a PWI. In addition to his studies, he participates in undergraduate research through an on-campus program geared towards increasing underrepresented minority participation in research. He became interested in STEM in a desire to create more sustainable power resources for his home country in Africa.

Judah. Judah is a non-traditional student who works full time at the PWI in which he attends and where he is also pursuing an undergraduate degree in Psychology. He has been working at the university for several years and taking classes towards his degree after losing a scholarship during his first few years of college. His experiences as both a traditional and non-traditional undergraduate student in STEM have led him to desire to mentor and advise students pursuing STEM degrees.

Khalil. Khalil describes himself as an immigrant student in Information Technology at a PWI, although Khalil self-identifies as an immigrant student, he has spent many of his formative years within the United States and believes himself to be well adjusted to the U.S. culture. In addition to his studies, Khalil has worked with his peers to create a high-tech start-up company. It is his hope that his interest and knowledge in STEM will allow his start-up to become massively successful.

Malik. Malik is a non-traditional student pursuing a degree in Statistics at a PWI. Malik currently holds a bachelor's degree and is intrigued by learning, which influenced his decision to re-enroll into undergraduate education in pursuit of an additional degree. His goals upon graduation are to pursue a terminal degree.

Omar. Omar describes himself and his experiences an immigrant and non-traditional, transfer student majoring in Engineering at a PWI. In addition to his studies, Omar participates in a program that seeks to grant undergraduate research experiences to minorities in STEM. It is his hope that he can utilize his degree to gain employment at an engineering company and later work for a non-profit organization helping other minority students pursue degrees in STEM.

Roy. Roy is an undergraduate student majoring in Engineering at a PWI. Roy is involved in several on-campus clubs and organizations and acts as in an official capacity on the advisory councils. After completing his degree, he wants to commission into the United States Armed Services to become a pilot and later pursue a career building and designing aircrafts.

Shyheim. Shyheim is an undergraduate student majoring in Environmental Sciences. Shyheim is involved in several on-campus clubs and organizations. Additionally, he is currently interning in an on-campus office conducting applied research to increase campus sustainability.

He hopes to find a successful career upon graduation that will allow him to continually learn and adapt.

 Tyrik. Tyrik is an undergraduate student majoring in Natural Resources and Environmental Design at an HBCU. In addition to his studies, Tyrik has had the opportunity to participate in undergraduate research, being invited to work in a lab with one of his professors. Upon graduation, Tyrik plans to use his degree to start a career as a urban farmer for a non-profit creating community gardens for low-income communities.

 Xavier. Xavier describes himself as an immigrant and undergraduate student majoring in Engineering at a PWI. He is currently an active member in several on-campus organizations and is seeking to broaden his professional experiences. Upon graduation, Xavier hopes to use his STEM degree to gain employment that allows him to work towards solving issues related to energy crisis in developing countries.

 The above descriptions provide counternarratives about the background and goals of each of the participants within this study that will be used to provide data points to help shape interpretation of the experiences and viewpoints of shared by those within the study.

Research Question 1: How does one's expressed behaviors compare to one's problem-solving style, academic motivation and subscription to black identity?

 Adaption-Innovation theory posits that each person has a preferred method of problem-solving, which can be measured on a continuum of 32 to 160 points, classifying persons as either more adaptive (scores being closer to 32) or more innovative (scores being closer to 160) in the methods that they choose to utilize to problem solve. Within this score, are three constructs, SO-sufficiency of originality, E – efficiency, and R – rule/group conformity. Based upon this theory, the behaviors of individuals participating in this study will be described and compared to their

overall KAI scores and construct scores to determine if described behaviors confirm scores or indicate that coping behavior may be occurring among these individuals. The behaviors described below are derived from interview responses about participant experiences. KAI scores will be further compared with AMS and MIBI scores to determine relationships between behaviors, problem-solving style, motivation and black identity subscription.

Malik.   Malik is a non-traditional student entering the university to pursue a second undergraduate degree and eventually desires to pursue a Ph.D. Malik had an overall KAI score of 76 with sub-score of SO- 38, E – 13, R -25 indicating that he has a more adaptive problem-solving preference. Malik's AMS scores were IM – 4.58, EM – 5.83 and AM – 3.5 indicating somewhat less intrinsic motivation that that of his peers but higher extrinsic motivation. His amotivation score was also higher than that of other study participants. Malik's MIBI scores were Centrality – 1.38, Ideology – 5.00 and Regard – 2.5 indicating a lower individual subscription to black identity, high ideologies about the behaviors, interactions and expectation of black people as a whole and lower regard for the collective esteem of the group.

Malik's experiences as a nontraditional student and as one pursuing an undergraduate degree for the second time, his experiences are unique as both an older student and secondary undergraduate degree holder. When asked to describe an incidence related to his racial background that has impacted his experiences in STEM, he stated the following:

> In terms of STEM, well, so those experiences that I mentioned came really early on. So those ones not so much. But I guess when, especially during my first years as an undergraduate, and going to certain black professional science organizations, just seeing, hearing talks about the struggle to get funding, and the challenges that other people have gone through are obviously influencing. Being able to integrate into various work groups, specifically ... I imagine being here for example, a lot of the ... There is [sic] very few black students in a lot of the STEM classes that I'm in. There are some, but there are not

very many. We don't tend to pool together just because we're black or anything, so I don't really hang out with them very often. I would imagine that some people find it maybe easier to acclimate into certain sort of situations or having parents who come from more, you know, being from a higher socioeconomic class, being more acclimated to certain things that just help them get along better, or have a better network to get better internships, that sort of stuff. Just, not having those sort [sic] of advantages becomes apparent.

Malik's description of the ways in which he believed his racial identity impacted his experiences in STEM are not only indicative issues with inclusion, but also hint at coping as he discussed the black students sitting together and the intersectionality between race and socio-economic status and how those factors interact to produce advantages for some and disadvantages for others. While low socioeconomic status does not necessitate one's identification as a person of color, historical practices have often resulted in the inability or difficulty to obtain resources that would allow black students to be better prepared for entrance into the STEM field.

Malik went on to describe himself and the challenges that he's had with faculty members and peers by describing his thought processes:

A lot of times, sometimes faculty members, they tend to gravitate to certain people in class, they just like those people, whether they bond on personal level or for whatever reason. I'm not a very social person, I'm very introverted. So, by nature, that just makes it harder to interact with professors and peers. But I tend to just have ... I'm also a very liberal person. So the sort of questions I ask, I tend to perceive things in a very specific way a lot of times. It's harder to relate, sometimes, in that sort of way.

While introversion is not a characteristic associated with adaption or innovation, Malik's thought processes and desire to think, perceive and understand information in very specific ways are indicative of a more adaptive problem-solving preference. This statement also offered hints that coping due to differences in problem-solving preferences were occurring as he described

difficulty relating to faculty and peers due to the specificity in which he preferred to understand

and communicate. He further corroborated this analysis as he discussed how he described his

processes for visiting and interacting at a career fair:

> So in terms of like a career fair, we've had classes ... You know, sessions where we've talked about, in preparation for that, meeting with recruiters and that sort of stuff, like how to present oneself, and how to ... Like certain things, what to say, and coaching yourself, coaching ourselves on what to do. So, I would say that's probably one area in which I've had to feel like I've maybe changed how I normally am to meet a certain ideal. Trying to think of what specifically these people want to hear me say, have specific anecdotes, and strong action words, and making direct, constant direct eye contact, and being very cookie cutter.

Malik's desire to be "cookie-cutter" within the career fair setting is indicative of a

strongly predilection towards adaptive problem-solving by his identification of social norms

associated with STEM culture. When asked to describe his experiences in working within

collaborative groups to complete STEM assignments, Malik shared:

> They vary, depending on which avenue of STEM you're doing, because I've been in computer science projects where you use a lot more coding and more programming versus like other assignments for other science classes that I've been in where it's not as programming based, and it's more research, and working on a project. So, the way you divide things up is actually very different in a lot of ways. The role I feel best suited to is identifying the best strengths of the group. A lot of times in collaborative assignments, I feel like the best way to create the cohesion, because I'm someone who I feel like is very good at being analytical and deliberating with the group to plan out what would be the best strategy. So, I feel like that's a role I typically take, trying to map out what would be the best things to do. Then helping to guide delegation of those roles to maximize utility of our efforts.

> So that's the role I typically take in a lot of things. I also tend to do more of the theoretical work, in a lot of roles. So, like if it's a math sort of things, like writing out the equations, or figuring out basically a theoretical framework for what we're going to do. Then coming up with ways, that goes into the planning thing, but more ... The planning part is more like delegation, like actual tasks versus more of a conceptually, what we're

going to do. That's sort of the role I tend to take. I don't usually like to be ... I'm not someone who likes to be super authoritative, I don't like to feel like I'm dictating to someone, like you do this, you do that. But I also like tend to be someone who does a lot of the time management. So, like making sure things are organized, that sort of thing. I usually like to be ... I guess if there is a hierarchy in the group, I don't like to be at the top, but I like to be like second to the top… Someone who, the power behind the throne.

Malik's problem-solving style also correlates with his problem-solving preference of adaption, seeking group cohesion and focus on planning. However, his desire to be the "power behind the throne" implies that he may be coping and acting in the role as an advisor or pseudo-leader in an effort to ensure that his voice is not overlooked.

Judah. Judah is a non-traditional student and university employee who describes himself as a mentor or coach with goals to continue working at the university in a capacity that allows him to work with students. Judah had an overall KAI score of 93 with sub-score of SO – 45, E – 21, and R – 33 indicating slightly innovative SO and E scores with a more adaptive R score. Judah's AMS scores were IM – 5.25, EM – 5.17 and AM 2.50 indicating that he is a fairly motivated individual. Judah's MIBI scores were Centrality – 1.88, Ideology – 4.50 and Regard – 2.42 indicating that he had lower subscription to individual black identity constructs, high ideology beliefs and lower esteem and beliefs related to collective black identity.

Judah's educational journey has also been somewhat different than that of his peers. Judah entered the university as an incoming freshman on a scholarship and a participant in the university Corp of Cadets before losing his scholarship and beginning employment at the university and continuing studies as a part-time student. Each of these experiences, has provided Judah with a unique perspective concerning his interactions within the STEM field. Asked to describe how his awareness of his racial identity impacted his feelings of belonginess in STEM,

he described learning about his acceptance to college and being awarded a scholarship and then

being questioned as to if it were a football scholarship:

> Like when I found out I had a scholarship, being asked if it was a football scholarship. I don't know. Just people thinking that, I don't know. It was little subtleties like that. Where I realized that ... I don't know. People saw me through a different lens, if that makes sense.

Within this statement, Judah describes his perception that others believed that would not

be able to receive a collegiate scholarship unless it was an athletics scholarship. He further

described interaction and conversations with his instructors and peers and the feelings of being

disconnected or unheard.

> When I was in the Corps and I had lost my scholarship, and I had went [sic] to one of the officers who was a faculty member, worked for the university… I was telling him about my situation. I don't have the money to be here, that scholarship was like my hope, and ... I don't think I'll be able to continue in the Corps Cadets unless there's ... some kind of funding that you guys can get me, and ... I felt like he really didn't ... he really wasn't listening. He had his own agenda, which I don't know what that was, but he was very much ... what he had to say was, "You're making the biggest mistake of your life. If you get out of the Corps, you're making the biggest mistake of your life." And instead of really understanding what I was trying to tell him, he just kinda [sic] dismissed me and said, "If you get out of the Corps, you're making the biggest mistake of your life."

> With my peers where there was – conversations about ... Trayvon Martin and different situations that have, or Colin Kaepernick, different things like that, and having difficult conversations about my perspective, and explaining my experiences regarding racism and discrimination, getting pulled over by a police officer and them having no reason to pull me over, and being asked if I had drugs in the car, when I had never done drugs before in my life, et cetera, et cetera. Having to have difficult conversations around those topics. I would say is probably some of the more difficult moments that I've had with my peers, and just trying to get them to understand another perspective that they obviously have never experienced, but they can be quick to kind of close off.

Judah's description of his interactions with faculty demonstrate a lack of cultural competency and awareness of both his faculty and peers. The dismissal of Judah's conversations about issues impacting him and those within his community indicate a lack of concern or desire to confront the issues facing him. As these issues are summarily dismissed, the cycle of colorblind reasoning is continually perpetuated negating his lived experiences as a black man in the United States and the lived experiences of those like him. Additionally, his comments hint at the critical race tenant describing the perceived competence of minorities to have conversations about race and racism.

Although Judah has faced a number of issues surrounding the completion of his degree, it has motivated him to work to mentor other students. In mentoring with students Judah described his process as follows:

> I've actually mentored a bunch of students that were in the STEM field. Normally it starts with us being in a similar organization, or I meet them playing basketball in one of the gyms on campus and have a conversation. Really kinda [sic] hit it off, and decide to meet up for lunch or something outside of that organization's meeting or something like that. Then we begin to chat and I just really feel like I can relate to their story or their struggle and just kinda [sic] want to help them kind of navigate that space. And so we begin to meet up more regularly. It's a very personal relationship. I feel like vulnerability and transparency are key to any good mentor-mentee relationship, but that's also balanced with setting goals or reading books together. Different things like that that will help them in their career"

Judah's approach to mentoring students is inherently tied to his experiences in STEM as it relates to the discounting of his experiences. His interactions with these students indicate a desire to reaffirm them and their identities in a space where they may be overlooked.

Similarly, when asked to discuss his process when working collaboratively on STEM assignments, Judah stated the following:

I think, like group assignments would… I actually… I think that's one of my favorite parts of the STEM field, because I'm a people person. I like really working and learning from other people. I think everybody brings…. Different lens to the table, and so I thin working on group assignments with other people who don't look like me and don't think like me and haven't had the same experiences that I have, it always presents, its fair share of challenges, but also opportunities for me to grow, for me to build relationships with other people.

Judah's description of his interactions with students that he mentors and his preferred ways to work within collaborative group settings, it could be hypothesized that Judah has a more adaptive KAI score. Judah's identity as a mentor is one most prevalently discussed throughout his responses to the interview questions. As a mentor seeking to establish relationships with students, it can be postulated that he is adaptive as he works with students in this capacity to build upon the existing knowledge, needs and desires of a student without pushing them too quickly outside of their comfort zones.

Darius. Darius is a student who describes his overarching goal and motivation for degree completion as being able to help develop sustainable power or electrical infrastructure for his home country and other countries in Africa. Darius's KAI score is on par with the average KAI score for males. Sub-scores for the KAI were SO – 45, E – 21, R – 33. Darius's AMS scores indicated that he was a fairly motivated individual with IM – 5.25, EM – 5.08 and AM – 2.0 which were only slightly below the averages for the overall sample. MIBI scores for Darius were Centrality – 1.63, Ideology – 4.19, Regard – 2.83 indicating a lower individual subscription to black identity, fairly high beliefs and opinions about collective black identity and behaviors and fairly low esteem about collective black identity.

Darius's educational journey has led him from the continent of Africa about five years ago to the United States, where he began his pursuit of higher education at another institution

before transferring into his current university. Darius's experiences growing up in another country and immigrating to the United States as well as his educational experiences at another educational institution have influenced his perceptions and interactions in his quest to obtain his degree. When asked to describe how he first became aware of his race and how the awareness of race impacted his experiences in STEM, Darius responded with the following statements:

> Well, when I moved here from Africa, maybe three to five years ago ... especially in high school. That's where you get a little bit more 'cause you just first move here and how the kids ... you're new to the environment. So, I guess knowing about it is probably like in high school, when you just first got here. Where you feel a little different compared to everybody else by the way you talk, by the way you speak, by the way you look. You just feel different sometimes, but after a while, you fit in and it just all goes away.

> Definitely it has motivated me because we don't have a lot more opportunity as the race that we're in. It kinda [sic] pushes you to want to be the better person in your field, to be able to show them that, "Hey, just because I'm from here or this does not mean that I can't do what you're doing, or even more." It has definitely motivated me.

> Sometimes, just because they're in America and they know more stuff here than we do, they typically tend to always favor them over us. Knowing that in the back of my head, pushed me. I said, "Okay. You know what? Everybody's going towards this person because they think they know more or they ... It's normal for them to get this grade." That kinda [sic] pushed me or nudged me a little bit to say, "You know what? Just because you're this or just because of that, I'm gonna [sic] push myself to get above you."

Within the context of identity, Darius describes being viewed through a deficit perspective based upon his identity as a both an immigrant and as a black man. The perceptions that his racial identity and country of origin are associated with a lack of intelligence have caused Darius has begun to cope with these perceptions, he has developed an increased motivation to succeed in an effort to prove a point of capability. The treatment and perceptions described by Darius are also indicative of the role of implicit racism or biases influencing the ways in which

faculty and students interact with him and the strategies that he employs to disprove their assumptions. Darius's high scores on the AMS may be a result of his coping in an effort to prove himself and his lower scores on the MIBI may be representative of the internalization of negative stereotypes associated with being black and being an immigrant. However, Darius perceived that within this group, his failures, not his success conformed to what was expected of him. Pushing against these perceptions and group beliefs, Darius motivation to disprove the group and to succeed forced him into his chosen coping strategy.

When working within groups for collaborative projects, Darius believes that he functions best as a manager:

> Usually, I like to not be the leader. I like to be someone who's able to fully talk to everyone on the team about something or what we're doing. So probably be the initiator. Talk about like, "Hey, we need to get this done." Or, "Hey, what you guys think." Kinda [sic] getting close to a leader, but I like to get everybody involved in the team. Make sure that everybody's voice is heard. Everybody is important in the group or on the team.

> Close to being a leader. Just making sure everybody is okay ... comfortable, working as a team. That's what I like to do.

Darius's description of his interactions within groups indicates that he may be a "bridger." A bridger is a social role for individuals who take on responsibilities of helping more adaptive and more innovative individuals communicate better with each other (Kirton, 2003). His overall KAI score of 98 is close to the mean KAI score of 95. Darius's identity as a STEM student seemingly took a back seat to his identities as both a black male and as an immigrant. By facilitating many of the interactions within the group, Darius's behavior indicates that he possesses strong leadership skills but his desires to remain behind the scenes in the decision-making process may be indicative of coping as he shies away from the official title of leadership

and ascribes a supporting role to himself. This indicates that he is uncomfortable being the representative of his group although he has the skills to do so. The deficit perspectives that Darius described may also impact him when working in a group session, necessitating that he functions in an undefined role of leadership as a coping strategy in order to have his expertise more readily accepted by the broader group.

Roy. Roy is an undergraduate engineering student who describes his career goals as commissioning into the United States Armed Forces upon graduation with hop to become a pilot and aircraft designer. Roy's overall KAI score was a 101 indicating that he has a more innovative problem-solving preference. Roy's KAI sub-scores were SO – 40, E – 17 and R – 44. Roy's AMS scores were IM – 5.25, EM 6.00 and AM – 2.00. These scores indicate that Roy has fairly high intrinsic motivation, high extrinsic motivation and fairly low amotivation. Roy's MIBI scores were Centrality – 2.50, Ideology – 2.75 and Regard – 4.28. These scores indicate that he has a slightly higher individual subscription to black identity than his peers, lower opinions, expectations and beliefs about how black people should conduct themselves and a high regard for black people collectively.

Roy is a traditional student, entering the university upon graduation from high school. He is very active on campus, serving in organizations that allow him to help plan on-campus events. He describes his hometown as one that was racially diverse and experiencing a sense of shock at the lack of diversity experienced by some of his classmates. When asked to describe if and how his racial identity influenced his experiences in STEM, he stated the following:

> Definitely, because it's one of those things when you're looking through the books you don't see too much people who contributed to those success stories that look like you, when in reality there's plenty. You just don't see them and then you have to actually just

> dig and dig and dig to find somebody of my race that actually impacted and contributed, but doesn't receive any credit.

> Basically, I guess when you're taking your courses or what not. It's like to me even high school sometimes. You may have white counterparts who may joke around. You know you got into that school based upon Affirmative Action, like quota, like that. Not even like simply, purely based upon you actually put in the work to get to where you are today or basically like they may not feel like you can handle a certain project or something like that.

Roy's description about seeking to find others that look like him is evidence of coping outside of culture. Mainstream media has all but concealed the contributions of people of color to the STEM field, forcing students like Roy to search to find evidence of their belonging in the field. Compounding this issue is the perception of white peers that he could only enter into STEM based upon Affirmative Action and not by his own merit, revealing that he was also viewed through a deficit perspective by his peers. This demonstrates the inherence of racism within society, despite the fact that Roy is a competitive student, his knowledge was discounted due to his racial background.

Roy further described expressing his identity in STEM in the following statement:

> I usually, I just go about it like always having a creative and yet straight forward mind at the same time. I'm a very analytical thinker. I like to take on things piece by piece, step by step and also just making sure I have a, I like to understand the big picture before I go down to the micro details, so I just work outside in… Basically I had friends who and these are people I recently met in college and then some I knew for a minute and now we like still in the same school, but they basically say that I take initiative and I express leadership traits or I can basically do, I can do a lot, but I don't really, not one to step in the spotlight and have to get all the glory for it. That's usually my take on things, like I don't mind just doing things and know that I did it. Not taking like, like it wouldn't bother me too much for not taking the full credit.

When asked to further describe himself and the ways in which he prefers to interact within groups to collaboratively resolve STEM based problems, Roy described himself in the following statement.

> Usually, when I work on a STEM team or engineering team it's very I guess, it's like you go through different phases on a team… I'm more so a person that'll basically, I will take the lead, but then I'll be like a group compromiser so I'm like that middle man to basically negotiate, basically manager what needs to get done. What we need to have a plan by. That way you don't have a whole lot of bumping heads and like you know, if I was working on this. If I was working on this, but I'm more so like a task delegator. I'll delegate stuff to people just to make sure it gets done.

> To make sure that they converse their challenges or what not to me so that way I can make sure that we get it done as a team. I'll take it or somebody else take the task. I tend to like I'll be the person to basically either we're going to like the presentation or the documents itself to make sure everything looks presentable and that we have a basis for whatever project we may be doing. That's usually my role as far as I'm the one that can express the ideas at the end of a project when it comes to expressing the concepts.

Based upon Roy's description of himself and the ways he prefers to interact within groups, it would seem that he is more adaptive, working to ensure group efficiency. Although Roy has an overall innovative KAI score, however, preferring to focus on efficiency of the group by taking on any task needed is indicative of his more adaptive E score (with respect to the Efficiency scale mean of 19 points). His description as a middle man or negotiator, may be related to his preference of a slightly more innovative individual, being six points more innovative than the population mean, as he is able to see all the connections and communicate them well with the team. Being extremely more adaptive or extremely more innovative would hinder his communications with the rest of the group. However, Roy insinuates that he is coping based upon expertise. Early on in the interview, Roy describes not seeing many people of his same racial background represented in easily accessible STEM-related media, however he also

describes comfort in the self-gratification of completing assignment, stating that he doesn't mind if he does not get credit.

Xavier. Xavier is an undergraduate student majoring in engineering. He describes his goals upon graduation as desiring to obtain employment that will allow him to help others in less fortunate countries specifically as it relates to energy. Xavier has an overall KAI score of 105 with sub score of SO – 53, E – 24 and R – 28. Xavier's AMS scores were IM – 4.92, EM – 5.92 and AM – 1.75 indicating slightly lower intrinsic motivation and amotivation than that of other study participants and higher extrinsic motivation. MIBI scores were Centrality – 1.38, Ideology – 5.42 and Regard – 3.48. These scores indicate that Xavier has a lower individual subscription to black identity, high expectation and opinions about the ways in which black people should interact or behave and a slightly higher esteem for black people as a whole.

Xavier is a student that immigrated to the United States at a young age and who is a traditional student, entering the university upon graduation from high school. His perspectives and experiences as a traditional student and immigrant provide him with an interesting perspective about the STEM field. When asked to describe the ways in which he believed his racial identity impacted his experiences in STEM, Xavier shared the following statement:

> In middle school, I began to realize I was different from my colleagues, in the sense that I wasn't from here, and then in high school I was told that the fact that I'm an African American, to better myself in society, especially with the fact that I wasn't born into STEM. I was told that I could make myself stand out because I'm not someone that's coming in this industry.

Xavier further described the ways in which he expressed himself and his identity within his field and the impact that he believed his self-expression had on others.

> By the clothes I wear, and talking about the organizations I'm in. Like, I have certain clothes that have the symbol of the organization I'm in and I wear it around. And I also talk to my friends about joining these organizations… because they do see me sometimes, like different from them. I've heard black people have got into college because of a favorited reaction, so that's like seeing students as getting into college because they're black.

Xavier's description about the impact of his identity on his experiences in STEM indicate the roles of intrinsic motivation on motivating him to pursue a degree in STEM. However, his statement also revealed the internalization of difference based upon his status as an immigrant and the somewhat forced assimilation into African American culture by others assuming that he identified as an African American. The conscription of this identity had the potential to cause cultural coping to occur as Xavier was summarily included in to the culture of African Americans born in the United States. Xavier's entrance into STEM was also somewhat compulsory as it seemed that he was told that STEM was his best option for future career growth and employment. Xavier has seemingly embraced the ways in which he perceived in STEM by seeking and creating his own communities by joining organizations and encouraging his friends to join. This simple act of resistance, creating a counterculture that espouses STEM education but is more inclusive, demonstrates Xavier's motivation to succeed and his usage of on-campus student organizations as coping strategies that he uses, despite facing micro-aggressions about his entrance into college or abilities to succeed in the STEM field.

When talking about his needs as a student, Xavier began describing a situation where he worked through course assignments differently than the methods taught by his instructor.

> For my, my Physics class last semester, I solved my problems differently than the way he presented them in class, but I still got the right answers. And then when I went to his

office hours and showed him a different way, he understood where I was coming from and helped me do it better.

This statement highlights Xavier's innovative problem-solving preference, by seeking to solve problems differently, but also highlights motivation as he seeks out his instructor in order to demonstrate his understanding of materials. However, it can also in some ways highlight the subtlety of racism as Xavier was forced to demonstrate his knowledge and the validity of how he came to his response seemingly indicating a question of his abilities and the role of an instructor as a gatekeeper of knowledge. This speaks to the ordinariness of racism as this practice is not blatantly racist, yet its overtures are very much grounded in a paradigm of racism because it is unlikely that a student who was not a person of color would be challenged on his or her knowledge in this fashion.

Xavier further described his experiences working in collaborative peer groups with the following statement.

I'd definitely say there's a lot of communication, as ideas tend to change a lot and there's also the need for people to work overtime in a sense. Like, even though there's an assigned time to work, there needs to be at least one person that has to do more than everyone because STEM projects tend to be really tasking and take a lot of time to fully develop one concept that works perfectly.

I tend to be the person that can help out with everything. If someone needs help with something, I can step up and be that help. And I ... necessarily want to be the manager, but I do want to help out as being a leader sometimes.

Based upon Xavier's description on how he interacts within groups, it can be hypothesized that Xavier acting more innovatively with respect to the KAI inventory with focus

on communication of ideas changing. Xavier's last comment about wanting to be a leader

sometimes also seems to indicate an occurrence of coping with identity, seeming to indicate that

he has had very little opportunity to act in the capacity of a leader and that he may question his

own abilities as a result of a lack of these types of opportunities.

      Antonio. Antonio is a student who describes many of his motivating factors as being tied

to financial awareness and the need to provide for his family and to continue the legacy of his

grandfather by using what he learns in his degree program to improve upon the existing business

structure of the farm that he inherited from his grandfather. Antonio's KAI score indicated that

he is a more innovative problem-solver with a KAI of 109. Antonio's sub-scores on the KAI

were: SO – 42, E – 22, R- 45. Based upon these scores, Antonio is slightly more innovative in

each construct, as expected given his total KAI score. AMS scores for Antonio indicated that he

is an individual that is slightly less motivated than other participants within this study with IM –

4.92, EM – 4.25, AM – 3.50 with intrinsic and extrinsic motivation scores lower than the mean

score of 5.43 and 5.26 respectively. His amotivation score is higher than the mean score of 2.45.

MIBI scores for Antonio were Centrality – 1.88, Ideology – 4.90, Regard – 2.5 with centrality

and ideology scores slightly higher than the mean scores of 1.68 and 4.75. However, his regard

score was slightly lower than the mean score of 2.68. These scores indicate that Antonio does not

see race as a core part of his individuality and self-concept, however he has fairly strong

preferences about the behaviors, beliefs and attitudes of black persons as a group. Antonio's

Regard score indicates that he has somewhat harsher judgement and lower collective esteem

about black people as a whole.

      Antonio's educational journey has been vastly different than that of many of his peers as

he has maintained an agricultural operation from a young age and throughout the entirety of his

educational career thus far, which may account for the variation in his AMS and MIBI scores. In addition to maintaining the agricultural operation, he is also dependent upon it to sustain himself and his family, indicating that he is one of the primary providers for his family and himself. These experiences have impacted and influences the ways in which he both perceives and interacts within the educational setting and the world around him. While Antonio identified as a student, his identity as a farmer and provider seemed to influence much of his perspective on how he interacted with the world and how he problem solved. When asked about experiences that made him aware of his race, Antonio began by describing an incident related to a time when he attempted to access financial resources to support his family farm:

> Well, going into my family history a little bit, my grandfather's farm. He owed money to the government. They wanted their money and there was other farmers with similar situations that I believe had more leverage and more lenience than we did and happened to be a different color. So, I presented that, and I said, "I don't feel this fair. I feel like there should be other options for us," and I explored those options the best I could. A lot of things came into play, so when I would try to, let's say I might not have the exact same features of as someone else of a separate color, but we would go in ... and a friend of mine, they went and got a loan for their farm and stuff. They made less money than we did and were able to get funding. I went to that same bank with my numbers, because we had already talked to some friends before, but we didn't really say we were going to the same bank and I found out that I was declined and I didn't understand why.

> So, it kind of made me think, "Well, maybe it's more than just the logistics. Maybe there's another side to it." I happened to be in ------ at that time, and it just blew my mind how certain things kind of rolled around, that I kind of found a little suspicious and I couldn't figure out why until I had family that would say, "Oh, it's because you're black" and all this other stuff and I said, "We're in a different time now. That should not matter," but as time went on, I started to see certain occurrences that I felt were just a little bit unfair. So, really, when I tried to make more business moves, it seemed like I had more restraint than others.

Antonio's experiences with the financial industry are an implication of the pervasive issues surrounding identity and practices inherently tied to structurally racist policies such as

discriminatory or inequitable lending (Duitz, 2010). The conversations between Antonio and his relatives indicated a belief that success was tied to one's racial identity and that because Antonio was an African American man, his successes would be limited. The bank's denial of his request also seemingly supported the statement of Antonio's relative. During this process, Antonio experienced cognitive dissonance as he grappled with the possibility that he had been denied assistance due to his racial background and the ways in which his ethnicity could negatively impact his successes. Antonio's low centrality scores can also be explained by his statement concerning his disbelief about the possibility of race-based discrimination. In an effort to cope with these factors Antonio began to seek out mentors and different opportunities and resources to make his farming practice more efficient.

Ms. ---, was a good mentor that I found a few years later. She had different views of agriculture than I did, and it interested me. And I saw it as something that could mold my farm since we were losing acreage that we leased. I seen [sic] it as an opportunity to make more money for less acreage. So, then she became my mentor on different agricultural practices that I use today.

In addition to seeking a mentor, Antonio also began seeking out the resources at his university in an effort to develop and implement different farming practices for usage in his agricultural operation. However, in doing this he found that many of his instructors did not have practical experience that he could utilize.

There's a lot of instructors that come straight out of college. There's nothing wrong with that. Or they get hired on the spot. They're do great work with people and everything, but I feel like having those professors that have been out there. But it's hard to find them too. Or that have that experience with professors in that field. Which we have a lot of them that do; some of them don't. I think that would help me more for that way. I could kind of communicate with my professors more because one issue I have with my professors is they would teach forestry or they would teach a certain type of commodity group, or

certain type of horticulture, or permaculture class. And they'll talk about way to grow it. And then when you talk to them about the marketing side, it's almost hit or miss. It's like, "Well, it could work depending on the trends." And I feel like, if this is something that I'm taking the class on, I would expect the professor, not only to have the information about how to grow it, but as a farmer, to be able to profitable with it.

This lack of resource accessibility also caused coping to occur, forcing Antonio to seek alternative methods to increase his profitability. As a result of the issues that he faced, he was motivated to change his business structure and wrote a grant to assist him with the process.

> I wrote a grant for a mobile farmers market where I was able to sell local produce at not only the farmers marker, but take it with me and set up anywhere. And it would take SNAP/EBT or WIC and whatever else along with credit and debit cards. So, I went on ahead and I had my business cards, changed my business cards. I changed my outlook of things. I tried to, what it was I switched from just being at the farmers market to being the mobile farmer, farmer's market. Being able to switch the way I sold my products and I changed the face of my business. And then I was able to appeal to a different audience that I wouldn't normally see because they don't normally see me. So, I feel that's something that kind of sparked a change in myself and my business.

In describing his roles and responsibilities on a team, Antonio described a farm project where he worked collaboratively with neighboring farmers to produce hemp and in regards to STEM, he described providing data or information from his farm for his classmates to use within various projects.

> One of my roles with collaborative I had is with two others farmers is we're doing a collaborative grant with RAFTI, which is just the Rural Advancement Foundation International, for a... we're collecting ourselves together for a new product called hemp. I have to barn some storage and my responsibility is to be able to carry it out and be able to get it ready for processing- bale it, box it. That way we can send it to the main processor, either for CBD oil or for however you want to use it for. The other two, he's in charge of growing it, laying seeds, and then also greenhouse. So, we work collaboratively to go ahead and push this all the way through so mainly, my role is just storage and make the end product.

A STEM assignment, okay. I guess a good example would be? I'm trying to think. Let's see here, ok, then, in one of my ag business classes, we had a group together, working on a STEM assignment, it was being able to use real data and put together on a graph and be able to show on a market trend. And they were trying to use real data so they wanted to use my actual data from my farm, so my part in that was to collect the data with the assignment. And we just worked collaboratively together to have the assignment ready in time for class… I'm trying to think of a better example. I mean, when we were in the FFA, or when we do breakfast- the students come in from different high schools and we, my team we were cooking sausage for them that morning. We had another part of the team doing tours. We had another part of the team getting it ready of information sessions and such. And that was a collaborative STEM. It wasn't more of an assignment but it was an assignment we were given by our professors and go ahead and do for our community. And my role was just preparation. So the first thing they see is a joyful face that is ready and eager to express my determination and eagerness for them at our university.

When asked to speak more towards his views on a expressing himself and his identity in

STEM, Antonio began to describe his identity as a farmer, seemingly combining the two:

Really, I express my identity by works that I do; what I'm able to do, and what I've learned in STEM. One of the elementary schools in my community, they had asked me about my mobile farmers market and they asked me to come by the school for career day. Well, you know, they had firefighters and everyone else; policeman. And I found that every astonishing that they would find me, let alone, I mean I don't know how they did, find my phone number and call me up to see if I would go ahead and show up for career day. So, to me, I try to help my community and show them that this is a career you could you be interested in; something they could use for the future like help the next generation.

So, my identity was the whole thing. This is who I am. This is how I do my living. And I enjoy it. I told the students, I said, they said "How much many can you make with this?" And I said, "As much as you want. It depends on how you want to push it. There is no salary cap." I said nothing against the other careers that are here. I mean they only make so much, that's fine. But agriculture is all about what you put in – either what you put in the ground or what you put in for your livestock, or what you put in for yourself. So, I feel like that created my identity in the community and also my identity for myself to let it be known that, yes, I am a farmer and I'm proud to be a farmer.

He went on to describe a successful STEM student as one having drive, motivation,

sensitivity and the desire to use STEM to realized one's goals. However, he did not view himself

as a successful STEM student, but instead as one that was developing as he worked to better his skills with time management. Antonio's statements about his participation in career day and conversations with the students further demonstrated his motivation and its ties to finances in addition to a desire to give back to the community. His statement about the numerous opportunities to increase financial gain in farming also spoke to his innovative nature demonstrating that he believes that there are a number of ways to make money in his profession that may or may not be traditional.

Given the salience of Antonio's identity as a farmer and the need for farmers to use or develop increasing unconventional methods to stay afloat, it seems that Antonio is more innovative on the adaption-innovation continuum. However, based upon Antonio's description of his behaviors and thought processes, it could be hypothesized that he is often coping as necessary to work within existing structures to produce capital to sustain himself and his agricultural operation.

He describes trying to build his grandfather's farm and finding that utilizing similar resources that had worked in the past he opted to change the paradigm of farming instead of focusing on improving efficiencies. This behavior is seemingly indicative a more innovative KAI score. However, Antonio also discusses the importance of efficiency and methods that he sought to increase his production, which is evidence of coping. Antonio's designation as an innovator may be viewed as more stringently tied to his identity as a farmer than as a black male or as a person in STEM. Although Antonio utilized STEM as a method to accomplish his goals as a farmer, but did not necessarily view it as an important part of his identity. However, it can also be inferred that structural racism and other biases increase the coping that Antonio experiences as it requires him to seek alternate routes to problem solving issues related to access and finance.

Khalil. Khalil is a student who immigrated to the United States at a young age and is currently pursuing a degree in engineering. In addition to pursuing a degree in engineering, he is also currently operating as a vice-president of operations within a start-up company and describes his goals as pursuing a career in project management within the next five years. Khalil's overall KAI score was a 119 indicating that he has an innovative problem-solving preference. Sub scores for the KAI were SO – 55, E – 20, and R – 44 indicating that he is innovative in each spectrum of the KAI. Khalil AMS scores, IM – 6.17, EM – 5.83, AM – 2.25 indicating high intrinsic and extrinsic motivation. MIBI scores for Khalil, Centrality – 1.63, Ideology – 5.39 and Regard – 3.25 indicating a lower subscription to individual black identity, somewhat high beliefs and opinions about how black people as a whole should interact and a slightly higher regard for the collective identity of black people.

Khalil's experiences as an immigrant, student and start-up employee offer a unique perspective into his experiences as a student. When asked to share information about learning about this identity as a black man and how this knowledge impacted him in STEM, he shared the following:

> I think when I was really young, cause [sic] I was born in Ethiopia, and I came here when I was 8 or 7, around that range. It was basically when I came to the airport, cause in Ethiopia everybody was black, came to the airport and I saw a bunch of white people and I was like, what? So, I was really confused about that. I don't know how it affected me with STEM because I just always liked STEM related stuff. I liked breaking and fixing things. Since I was a kid, my mom used to tell me I used to break all my toys just to see what's inside. I don't know if that has anything to do with it, but I just kept following that sense of wanting to know how things work.

Khalil's curiosity about STEM seemingly overshadowed his experiences with race and ethnicity. In addition to his natural curiosity, Khalil had an older brother that acted as a role-

model and mentor for his STEM interests. This engagement in STEM at an earlier age may

account for the development of a stronger STEM identity and describe why race was not as

salient a factor in his experience. Khalil further described his burgeoning interests in STEM by

describing a project that he participated in during high school.

> One example would be in high school. Me and my friends were in a computer science
> class and we were working on recreating the game Battleship. It was something that we
> had been working on for weeks and weeks and weeks, and just one day we all just sat
> there and looked at the coding and it just kind of clicked. And that was when I was like,
> wow this is something that I would want to pursue because it gives me the tools to create
> anything my mind can think of. And then honest this is what really made me feel like I
> could do that.

> And then I had another experience. There was a class in high school called STEM and we
> were just working on, kind of like the rocket, but just with compressed air when we shoot
> it. And we were working on that, and the whole process of designing something,
> calculating how it's gonna work, and then being able to experiment and see the results
> you were expecting; it just really solidified my thought process in the field that I wanted
> to go to.

Khalil's explanations about his interests in STEM and his thought processes about how

he became interested in STEM, describe his innovative problem-solving style. When asked to

describe how he expressed his identity is STEM Khalil stated the following:

> I don't know, that's something that I haven't really thought about until the beginning of
> this study. I'm me, I just do what I do, and that's it; whether you like it or not, it's me.

> I think a lot of people, like the way you express yourself is how they judge you, and they
> may see me as me not caring what I think about or what others think about me. I think it
> does impact me, and I think generally it does make you more likable. I don't know, I've
> noticed that people just like people that don't care about other people's opinions.

Khalil's description of his feelings towards expressing his identity and his perceptions about how others conceive him are also indicative of his innovative R-score because he does not need validation of the group or those around him to validate him.

Khalil further described the ways in which he interacts when working in a group, he stated the following:

> Usually, when I'm in a group, we like taking the problem and seeing if there's areas that can be separated. For our cube satellite thing we're working on, I'm doing the operations right? And so we took the big problem of how do we operate as a group, cause it's almost forty some people, so we are able to break it apart into concise groups of similar tasks, or somethings that are directly related, and assign people that have one, a particular interest in solving that problem, and two, the set of skills needed to solve that problem. So I usually like doing something I like solving and I'm capable of being able to solve.

Based upon Khalil's description of how he shares his identity in STEM and his MIBI scores in addition to his description about how he behaves within a group session, Khalil's innovative problem-solving style is highly evident in his day to day interactions. Unlike some of the other participants, evidence of coping in STEM was not highly evident with Khalil. This may also be due to his early exposure to STEM and having an older brother who could serve as a mentor, teaching him how to navigate within the STEM climate and helping him to set realistic expectations about his experiences within the STEM field.

Shyheim. Shyheim is an undergraduate student majoring in environmental sciences. He describes his goals upon graduation as obtaining a position in his field and being able to continue to learn and adapt from new ideas. Shyheim's KAI score was uninterpretable, however, based upon further interpretation of his KAI responses and information from his interview it can be hypothesized that Shyheim is a more adaptive problem-solver. Shyheim's AMS scores were IM

– 6.75, EM – 6.42 and AM – 1.00. Shyheim's MIBI scores were Centrality – 1.50, Ideology –

5.72 and Regard – 2.08. Based upon these scores, Shyheim has high intrinsic and extrinsic

motivation and low amotivation. MIBI scores for Shyheim indicate a low subscription to black

identity as it relates to him as an individual, fairly strong ideals about how black people should

act and interact with others in society and lower collective esteem about black people as a group.

When asked to discuss his identity and how he believed it impacted his experiences in STEM,

Shyheim responded with the following statements:

> I feel like I've always been aware of who I am, what my identity is, what my race is throughout my life. As soon as I could understand the concept of race as a person, I guess I learned as I grew up who I am, what race I am, and how that's important to me.

> It has been an impact a little bit. I don't feel like it's necessarily been a huge impact, at least in this moment of time, but I feel like it's important for me to be able to recognize the fact that there aren't too many people of color who decide, "Okay, let's study STEM." I feel like I'm kind of setting a trend, becoming a trendsetter in a way, by choosing to study STEM fields.

> I've never really felt like my race has necessarily limited me from doing anything, from achieving anything, or anything like that. I think it's just been something that I've gradually become more and more aware of as a result of just current events and things like that, stuff that happens that you even see on the news every day. Stuff like that has gradually made me more and more aware of race, and identity, and issues like those.

Shyheim's experiences with identity in STEM have not been paramount to his experience

in STEM, but have been salient in his recognizance of the opportunities available to him within

the STEM field and the fact that he is one of few minority males pursuing a degree in a STEM

field. Additionally, Shyheim believes that media coverage about race and various issues

surrounding it has begun to make him more aware of the issues that he may potentially face as a

black man. Shyheim further described how he expressed his identity in STEM and the ways in he

believed it influenced the way that others perceive him:

> How do I express my identity in STEM? I feel like when it comes to just strictly talking about STEM, I don't really feel as though ... Obviously identity itself is important, but in the STEM field I never really felt like it's been the most important thing because when I look upon who I am and who everyone else is studying STEM fields, it's just been scientist, people who really are passionate about the topic of study in the STEM field. I've never really felt like my particular identity has been of paramount importance.

> I definitely feel like that's [identity] important. I feel like how it has some sort of impact in regards to how others perceive me. I feel like I've benefited a lot from the way that I carry myself, and how I try and understand other people, and how I try and remain patient with them and understanding of what they're doing and how they're doing it. I feel like it has benefited me a lot.

The way in which Shyheim expresses identity as a black male has not colored his

experiences within the STEM field, in fact he seems to describe an experience that has not been

marred by racialized experiences. This could indicate equitable access to resources and

experiences but may also be potentially indicative of colorblind ideologies which may reaffirm

racism by failing to realize differences in student experiences. Although this ideology is not

explicitly stated, Shyheim hints at it in a previous statement about the pervasiveness of racialized

events in the media. When asked to describe his experiences when working in collaborative

groups, Shyheim explained the following:

> As a part of a STEM assignment, often it involves research, and different people collaborate in researching different things and coming up with new ideas as far as how to implement and how to present that research to not just necessarily a just scientific. I feel like a lot of the time when I'm working on a collaborative STEM assignment, or project, or whatever you have, I feel like a lot of my role has been to do the research, to dig down, and discover, and apply that knowledge that you can find, that you research. I feel like that's usually what I end up doing.

Shyheim's description of his role and behaviors when working within collaborative groups in many ways confirm the hypothesis that he has a more adaptive problem-solving preference. While he does assist in idea generation when working on assignments, he seems to excel in completing the research with the team and figuring out how to apply that knowledge, which is a trait of more adaptive individuals.

Tyrik. Tyrik is an undergraduate student majoring in natural resources and environmental design with goals of becoming an urban farmer, creating community gardens in low-income areas upon graduation. Tyrik's KAI score was uninterpretable due to a number of unanswered question responses. However, based upon analysis of his partial responses, it may be hypothesized that Tyrik has a more adaptive problem-solving style. AMS scores for Tyrik were IM – 4.75, EM – 4.25 and AM – 3.25. MIBI scores for Tyrik were Centrality – 1.88, Ideology – 4.05 and Regard – 2.75. Tyrik's AMS scores indicate lower intrinsic and extrinsic motivation than that of his peers and higher amotivation. His MIBI scores indicate lower individual black identity subscription, lower ideology or opinions about how black people should act or interact with others and lower R (regard) or expectations about black people as a whole. Tyrik is a traditional student who attends an HBCU. When asked to discuss how he became aware of his identity and how it has impacted his experiences in STEM, Tyrik responded with the following statements:

> They're, I mean, I'm not sure. Okay, I mean I see other people that weren't black. And then I've seen white people, Asian people, and they not, they not like me culturally.

Okay, not so much here at ----, which is an HBCU, but even still you see, like looking outside in the professional world, people with my goal, career choices, they tend to be not black.

Tyrik's expression about his experiences learning his identity as a black man is seemingly one that was evident from birth as he observed phenotypical and cultural differences between himself and those around him. However, he also explained that his status as a student at and HBCU in many ways sheltered him from interacting with persons who were not persons of color. Despite this fact, Tyrik also noticed that those broadly entering and persisting in his chosen degree field were not black people. Although Tyrik had somewhat lower motivation scores than his peers, acknowledging the lack of diversity in his field and the insulation that he has at an HBCU may accommodate for his lack of motivation. From this statement, it can be inferred that Tyrik believes he may experience difficulties upon leaving his university and entering into the workforce. Tyrik further described his expression of his identity with the following statements:

I'm a pretty reserved person so what I do in class, I do in work, it's not much. I just get the job done and go home.

I wouldn't do, like everything I do at home is not what I'd do at work. At work, I would try to carry myself in a professional manner as far as the things I say, or even if, like I listen to a lot of music, so when I was working in the lab, I couldn't do that. I couldn't play it loud like I normally play it at home. I being respectful to other peoples time and space.

Tyrik's statements about expressing his identity within the STEM field indicate a conscious awareness of the difference in norms permissible within a STEM setting, but also apprehension about bringing some of his personality into his field. Tyrik's first statement is

indicative of coping as Tyrik describes a duality of identity or double-consciousness in the ways that he interacts at home and within the professional or educational setting. Tyrik further described his interactions within group settings with the following statement:

> It can get tricky sometimes, working with other people. Everybody has their right answer so somebody has to be level headed and rational when it comes to trying to explain such." When asked if he considered himself to be that person he stated: "Rational, yes. I'm a level-headed person.

Tyrik's response to these question provided few details about how he specifically interacted with others when working on collaborative STEM assignments. However, his characterization of himself as seeking cultural fitness, striving to be professional and mindful of everyone's space, indicates a more adaptive preference of problem-solving style. His statement indicating his being a level headed and rational person seems to indicate that Tyrik may have previously worked in groups that experienced conflict and he was forced to act as a bridger. This would imply that although Tyrik's score can be interpreted as adaptive, it may be close enough to the mean score to allow him to cope with persons falling on each end of the adaption-innovation spectrum.

Omar. Omar is an immigrant and undergraduate student majoring in engineering at a predominately white institution. Upon graduation, Omar's goals are to obtain employment at a nonprofit helping to increase the number of diverse students entering STEM programs. Omar's overall KAI score was deemed uninterpretable, however additional analysis of his KAI results revealed that Omar may identify as slightly adaptive. AMS scores for Omar were IM – 4.91, EM – 5.08 and AM – 2.0. MIBI scores for Omar were Centrality – 1.13, Ideology – 4.08, Regard – 2.17. These scores indicate that Omar has somewhat lower intrinsic motivation than that of his

peers, fairly high extrinsic motivation and somewhat low amotivation. Omar's MIBI scores

indicate low subscription to individual black identity, fair ideologies for the behaviors, attitudes

and options of black people and low regard or collective esteem for black identity. When asked

to describe how he became aware of his identity as a black man and how he believed his identity

impacted his experiences in STEM, he described the following:

> Pretty much since I could speak. Yeah, like since I was really young – Especially here at ---, at least in my programs, so we don't have too many African-American or black students in my classroom, so it kind of gives you too much pressure that you have to perform very well, that if you don't perform well it's kind of like ... At least, me personally, I feel like if I don't do well it's going to be like a representative of other like minority [sic]. They're probably going to think, oh, African-American, they're like me. It was kind of too much pressure to do extra work so that I can stand out.

Omar's description of his identity and the pressures that he feels as an African American

man in STEM are indicative of coping. Within this statement, Omar implies that he must take on

an increased burden to prove himself capable of completing assignments in an effort to prove

himself. In order to cope with issues such as these, Omar has described seeking to develop

relationships with various faculty members and trusted friends, relying upon them to help him

learn how to navigate the issues that he faces.

> Even whenever I would go to seek for advice, sometime I feel kind of uncomfortable that it's going to reflect to our race that we are not as competent or competitive as others. So I try to solve issues or problems by my own before going to faculties and stuff like that. Yeah.

> I would probably call my other friends whom I knew are going through the same stuff, who didn't necessarily go to this school, to talk about the problem they have so that I can reflect from their experience to know how I can navigate.

Omar's description of feeling the need to prove his competence as an African American man and his preference for discussing issues with friends provide evidence of coping indicating that students such as Omar may enter into the classroom with the belief that instructors have negative perceptions about their abilities to succeed within the classroom. In addition to coursework, Omar has had a unique opportunity to informally mentor other students. When asked about these experiences, he described the following:

> There are students in my programs who are a minority, specifically like the African-American or African descents. They're kind of one year behind me. I will approach them and tell them what to expect and things like that, and maybe share with them some resources. But it wasn't like a formal mentorship, that I was higher, and they are below. It was kind of like friendship in a way. Yeah.

Omar's description indicates that he is in many ways seeking out the opportunity to mentor students, in an effort to shield them from some of the negative experiences or perceptions that he might have faced as he has matriculated through his degree program. In further discussion, Omar described the ways in which he expressed himself in STEM and the ways that he believed that form of self-expression impacted him.

> "My experience probably a little bit different from most people because I didn't grow up in this country. So, a lot of stuff I had to adjust. Like here, in terms of if you meet some in a professional setting, the way here they shake hands. Like back home, it would be if you made contact with somebody who is older than you, you usually use two hands. And here they told me it's kind of like show that you don't have confidence, so I had to adjust in terms of that – And also, yeah, I try even for dress code. I try to adjust what's considered professional in the US."

> I can't tell for sure how other people perceive me, but I found myself only open more when I'm in my community than here because I try to observe and see how they react about things so that I can react accordingly

Omar's experience as an immigrant entering into the STEM degree program within the United States forced him to cope as both a black man and immigrant learning the norms, tradition, dress and other cultural traditions appropriate within the United States. This ongoing learning and adjustment of behaviors to assimilate into the culture of the United States speaks to the structural and institutionalized discriminatory practices that pervade the culture of education. Omar later described his processes when working within collaborative STEM groups:

> The first thing is communication. Like to know exactly where you are, what's every single person on the team is supposed to do. Once you have that, then it's to make sure every person have [sic] done his part. If it's something which need to be worked at the same time, I mean where you have to sit together and talk it out, make sure everybody is contributing and everybody voices is [sic] being taken into consideration. – my role? For me, I don't know. I'm very adaptive, so it's really depends on how the team members are. Of course, I'm waiting to contribute. I always contribute, but most of the time I find myself that if most people are not willing to step up, I try to step up. But I'm not always somebody who, like the first second when you see them, I don't think I'm that person who always is the first to just come up. I just try to observe and see how things are. Based on that, I can react accordingly.

Omar's description about his role and processes when working with teams indicate that he moderates his behavior based upon the behaviors of others within the group. However, his focus on individual's responsibilities, process of group collaboration, consideration of roles, and making sure everyone is contributing indicates a more adaptive problem-solving style. However, it should be noted that his description of himself as adaptive was based upon his own definition and not necessarily the definition as defined by KAI.

While each of the participants scored on various ends of the KAI spectrum, it is important to note that one's designation as either adaptive of innovator does not guarantee that one behaves or interacts one way or another, but instead offers a description of the ways in which one prefers

to problem solve. One's preferred problem-solving style is highly resistant to change and established early in life (Kirton, 2013). As one is required in life to solve problems in ways that are vastly different from their own problem-solving style, they must cope or adapt to function outside of their preferred styles. This process is often psychologically taxing but bolstered by one's motive to solve the issue at hand. When broken down into behaviors more often associated with innovation versus those associated with adaption, innovators more often viewed as: risk takers, out-of-the-box thinkers and desiring less structure (Kirton, 2013). Conversely, adaptors are often viewed as: conforming, predictable, efficient and preferring more structure (Kirton, 2013). Within this data set, the majority of participants identified as innovators. However, many of the behaviors that they described such as organizing and structuring collaborative peer groups seem to indicate that these students are often functioning outside of their preferred problem-solving style revealing that coping is occurring. Note that the level and degree to which coping is occurring as students work within their groups can be highly dependent upon the problem-solving style of others within their groups.

In addition to coping that may occur as a result of differences in problem solving style and preference, coping may also occur in regard to culture and/or expertise. Many of the participants within this study expressed sentiments describing their knowledge or expertise being questioned by faculty or peers who did not believe them to be as knowledgeable about various subject areas. Culturally, many of these participants, particularly those identifying as immigrants hailed from communities or regions where their norms conflicted with the expected norms of those entering and persisting within STEM fields. The forced coping that occurs as a result of a need to assimilate into "acceptable" STEM culture is indicative of tenets of critical race theory, which normalize colorblindness, overlooking differences in experiences due to racial

backgrounds, failing to acknowledge the difference in experiences between native born African American's and those immigrating to the United States and the intersectional identities associated with their individual experiences.

The table below provides a summary overview of each participant's scores on the MIBI, KAI and AMS surveys.

Table 3
Interview Participant Demographics (N=10)

Pseudonym	School Type	Major	MIBI Scores	AMS Scores	KAI Sub Scores	Overall KAI
Malik	PWI	Statistics	C: 1.38 I: 5.00 Regard: 2.50	IM: 4.58 EM: 5.83 AM: 3.5	SO: 38 E: 13 R: 25	76
Judah	PWI	Psychology	C: 1.88 I: 4.50 Regard: 2.42	IM: 5.25 EM: 5.17 AM: 2.5	SO: 45 E: 14 R: 34	93
Darius	PWI	Engineering	C: 1.63 I: 4.19 Regard: 2.83	IM: 5.25 EM: 5.08 AM: 2.0	SO: 45 E: 21 R: 33	98
Roy	PWI	Engineering	C: 2.50 I: 2.75 Regard: 4.28	IM: 5.25 EM: 6.00 AM: 2.00	SO: 40 E: 17 R: 44	101
Xavier	PWI	Engineering	C: 1.38 I: 5.42 Regard: 3.58	IM: 4.92 EM: 5.92 AM: 1.75	SO: 53 E: 24 R: 28	105
Antonio	HBCU	Agricultural Education	C: 1.88 I: 4.90 Regard: 2.50	IM: 4.92 EM: 4.25 AM: 3.5	SO: 42 E: 22 R: 45	109
Khalil	PWI	Information Technology	C: 1.63 I: 5.39 Regard: 3.25	IM: 6.17 EM: 5.83 AM: 2.25	SO: 55 E: 20 R: 44	119
Shyheim	PWI	Environmental Science	C: 1.50 I: 5.72	IM: 6.75 EM: 6.42	N/A N/A	UI

			Regard: 2.08	AM: 1.00	N/A	
Tyrik	HBCU	Natural Resources & Environmental Design	C: 1.88 I: 4.05 Regard: 2.75	IM: 4.75 EM:4.25 AM: 3.25	N/A N/A N/A	UI
Omar	PWI	Engineering	C: 1.13 I: 4.08 Regard: 2.17	IM: 4.91 EM: 5.08 AM: 2.0	N/A N/A N/A	UI

Note: UI= Uninterpretable Score; Overall KAI Score is a combined total of SO, E and R scores

This section will describe qualitative data by reviewing the data analysis processes and discussing *a priori* themes and quotes as well as those emerging from the research. Data were viewed through a phenomenological study lens, exploring the beliefs and experiences of African American males within the STEM environment, seeking to determine and better understand shared experiences between members of the group. Trustworthiness was ensured through the process of member-checking, following up with participants to allow them the opportunity to clarify any shared information to provide input on conclusions made by the researcher. Data from this study were analyzed using processes of analytic induction and constant comparative analysis. The process of analytic induction allows for the determination of relationships between events or factors while the process of constant comparative analysis is the coding and recoding of data to determine the emergence of relationships between themes. Within this data set, interview transcriptions were first open-coded before focused coding took place. Based upon the focused codes, four themes emerged: (T1) Motivational factors and challenges to attrition (T2) Experiences impacting sense of belonging (T3) Mentorship as evidence of coping and (T4) Navigating multiple identities in STEM. Themes one and two offer insight into research question two and themes three and four offer insight into research question three. The table below provides an overview of the themes and a-priori codes and emergent codes from the interviews.

While there is significant overlap in codes and themes found between research questions three

and four, each theme will only be discussed once under the research question that it more

strongly aligns with.

Table 4

Thematic Analysis

Research Question #2	Research Question #3
Are African American males feeling a sense of belonging within STEM degree programs?	*How are coping behaviors being evidenced among African American men within STEM degree programs?*
Third Iteration: Emergent Themes/Application to Data Set	
T1: Motivational Factors & Challenges to Attrition	T3: Mentorship as Evidence of Coping Behaviors
T2: Experiences Impacting Sense of Belonging	T4: Navigating Multiple Identities in STEM
Second Iteration Focused Coding/Constant Comparative Analysis	
Theme 1	*Theme 3*
Motivation	Coping/Assimilation
Professionalism	Problem Solving Preference
Social Capital	Needs/Expectations
Perceptions	Imposter Syndrome
Mentorship	Barriers
Success	Perceptions
Role/Identity	Mentorship
Interest in STEM	Identity
Opportunities/Goals	
Belonging	
Imposter Syndrome	
Discrimination	
Theme 2	*Theme 4*
Discrimination	Role/Identity
Social Capital	Coping/Assimilation
Mentorship	Needs/Expectations
Role/Identity	Barriers
Imposter Syndrome	Perceptions
Interest in STEM	Mentorship
Belonging	

Participants were first oriented to the interview process and questions by being asked to discuss their ideal goals upon completion of their degree program. A few examples of participant responses are listed below:

- Eventually I'd like to attain a Ph.D. – Malik

- Actually on completion of my degree program, I want to commission into the United States Air Force as well. Basically, I want to become a pilot and fly and also later I want to design and build military aircraft and on the civilian side as well. – Roy

- Well, I would like to either move up in my current department where I work for the university or find another job that pays well. But definitely I would like to do something related to psychology, mentoring student, just working with students in general. Kinda' acting as like a mentor or coach. Kinda' counseling them and helping them to navigate their college and pre-college years as well. -Judah

- My ideal goals on completion of my program is to be able to take my grandfather's farm and be able to take it to the next level under myself, to be able to service my ideals with what I've learned in college and apply it to my everyday farming and just make it better and to be able to make a profit to sustain myself, and my family and my community. – Antonio

- My short-term goal is just to work for chemical engineering companies. My long-term goal is hoping to maybe work for like a nonprofit organization, specifically like helping other minority students to pursue their education in STEM programs. – Omar

These statements show a commonality between many participants and their future goals. The majority of participants responded by describing their desires to obtain employment that would allow financial stability and the opportunity to positively impact their communities. One participant indicated a desire to continue education to pursue a terminal degree.

Research Question 2: Are African American males feeling a sense of belonging within STEM degree programs?

Research question two sought to determine the sense of belonging as experienced by African American men pursuing undergraduate degrees in STEM or agriculturally related programs. Belonging was first assessed utilizing the MIBI to determine factors related to black identity and its salience to participants. Belongingness was further explored in the interview as participants discussed their beliefs, experiences and perceptions as undergraduates pursuing STEM or agricultural degree programs. Results were couched into two themes: (T1) Motivational factors and challenges to attrition (T2) Experiences impacting sense of belonging.

(T1) Motivational Factors and Challenges to Attrition

In an effort to better understand issues impacting retention, participants described their motivations and goals for continuing and desiring to complete their degrees as well as barriers that they believe hinder others from degree completion. Further confirming data from the Academic Motivation Survey, participants discussed factors that motivated them as individuals, encouraged their desires to enter into the STEM field and their perceptions about opportunities and challenges towards degree completion.

Participants more often had overall positive perceptions associated with successfully completing their degrees and reaching their career goals. Shyheim stated: "I believe that it is very likely that I obtain that goal. It's only a matter of time, but I feel like I'm pretty confident that I'll reach that goal." Similarly, when asked about the likelihood of reaching his goals after graduation, he stated: "95%." However, Malik a non-traditional student, was a bit less certain

stating that he believed that reaching his goals were: "somewhat likely," based upon concerns related to aging, health and finances. Xavier also expressed some trepidation stating that: "on a scale of one to ten, currently, I'm sort of a two, I mean four" due to his year in school [freshman], and the need to develop more skills and to meet more people. These positive perceptions about degree completion were most often associated with positive motivation, with extrinsically motivating factors being most salient. In addition to the factors surrounding financial stability, participants also indicated a motivating desire to make a difference in their individual communities through technological developments and service.

Challenges discussed by participants were mostly related to difficulties communicating with faculty and instructors, impacting social capital and influencing the development of imposter syndrome. Omar stated:

> "...knowing that you are the only person who look like you in the program of maybe like 90 students. It feels too much pressure. I mean, sometimes I would not perform as well. Not just because I'm African American or black, but because the material was hard, because even other people, maybe other people are failing. But sometime I couldn't took it that way. Sometime I start questioning myself, some sort of self-doubt that maybe it's because I'm African American, things like that. Even whenever I would go to seek for advice, sometime I feel kind of uncomfortable that it's going to reflect to our race that we are not as competent or competitive as others. So, I try to solve issues or problems on my own before going to faculties and stuff like that."

Similarly, Xavier expressed feeling as if he was viewed through a deficit perspective:

> "Sometimes I get overlooked, and when I say certain stuff in class, or when I solve problems, I guess they think I'm not that smart, that smart to think of something like that."

Within this sample population, two students were attendants at a historically black college or university. For these students, the challenges presented mostly related to developing a rapport with faculty members that allowed them to better account for a student's background or domestic situations when interacting with them. Tyrik, an underclassman participant at an HBCU described his challenges in the following statement:

> I feel like sometimes, you just feel as though some faculty members don't really understand where you're coming from. It's like, they're not black. We all got a story, not necessarily a similar story, but most black people can relate to other black people.

Antonio, an upperclassman and non-traditional student participant attending an HBCU described his challenges in the following statement:

> There are a lot of student here that are, how can I say – I won't say average students, but go through the same, go through the motions. All they have is school… But there's a lot of us I guess you would consider them as kind of like in the middle where they have a life, job, family or something like that and it's a little bit simpler. I feel like there should be some avenues in a four-year degree program that a university… I know they do it community colleges, but at a university where it may be just a little be more attention to help the best way possible.

Darius, an immigrant student described some of his challenges as a black male and immigrant as follows:

> Sometimes, just because they're in America and they know more stuff here than we do, they typically tend to favor them [non-black students] over us. Knowing that in the back of my head pushed me. I said "okay, you know what? Everybody's going towards this person because they think they know more or they… it's normal for them to get this grade." That kinda nudged me a little bit to say: "you know what? Just because you're this or just because of that, I'm gonna push myself to get above you" he further goes on to say. "…It pushes you to be the better person you are just because nobody's behind you, in a way, and everybody's behind the other person. It kinda pushes you. Okay. You know what? If I wanted him to know what I am or what I can do, then I need to do better than he's doing.

These statements indicate an urge for students to connect with their faculty and instructors beyond an instruction to facilitate a deeper professional relationship and understandings between both student and faculty member. It also evidence of how the perceived nature of these relationships and interactions impact the way that students view themselves, how they believe they are viewed by their peers, their abilities to persevere within their individual degree programs and provided insight into where students feel they need more support. This information expresses the importance and need for the development of relationships or communities to develop social capital between instructors and students and to support the development of a strong STEM identity among students. Students from both the HBCU and PWIs represented in this study expressed feeling like their instructors didn't always understand their backgrounds or the issues that they faced, however the HBCU students also seemed to be more confident or comfortable approaching their instructors than students at the PWIs.

(T2) Experiences Impacting Sense of Belonging

Most of the participants perceived a number of issues negatively impacting their experiences within their individual programs, mostly relating to building and sustaining positive relationships and interactions with faculty members and peers in addition to satisfying their individual curiosities.

Participants within this study often indicated that some of their first interactions with STEM content created the impact that encouraged their desire to pursue an undergraduate STEM or STEM related degree program. Shyheim recalled becoming interested in STEM as a young child:

As soon as I knew how to read, as soon as I knew… the interests of STEM-related things like different fields like biology, I loved reading about animals as a kid and just researching that on my own, or reading about chemistry, or reading about how the earth works, how our planet works in different ways as a kid. It started young for me I feel like - and it some field where my knowledge has only increased.

Similarly, Malik shared learning and becoming interested in STEM started at an early age.

I would say probably a lot of it came from cartoons growing up. I always like really identified with the scientific genius characters, you know how they could create anything or solve any problems. I was really into like fantasy and magic and that sort of stuff. The closest thing that comes to that in real life would be scientist being able to create things, and solve problems, and make solutions out of seemingly impossible problems. So that was sort of the inspiration and draw for going into STEM.

While the majority of participants had some STEM exposure at an early age, more often than not, this exposure was informal and many did not recognize it as being STEM. In fact, most participants expressed becoming aware of STEM through their own research, connecting their individual interests to the field or being told about the field from someone external to their households. This indicates that these participants are often the first in their immediate families or households to pursue undergraduate STEM degrees. The lack of multicultural representation in STEM also played a role in the realization of STEM interests from an earlier age.

Although STEM interest is an important factor within the student experience, as are factors of relationship development and involvement in STEM related groups or activities that enhance the student experience and sense of belonging. The majority of student participants in this study had previously or were currently participating in an extracurricular, on-campus organizations related to their cultures, majors or career goals. However, most described their level of participation within these organizations as declining as they matriculated further into their degree programs. The decline in participation with these organizations can in effect, cause conflict between the students' developing professional or STEM identity and personal identity as

they are forced to choose one community over another in an effort to be successful within STEM and forcing them to cope. While prioritizing academics is important, this decline in extracurricular participation can also detach the student from supportive on-campus communities and may cause a sensation of the loss or denigration of identity as the student chooses one group over the other, unable to participate in both due to workload or other constraints.

Research Question 3: How are coping behaviors being evidenced among African American men within STEM degree programs?

Research question three sought to determine if coping was occurring and how it may be evidenced among African American men pursuing undergraduate degrees in STEM or agriculturally related degree programs through participant interviews. Results fitting within these parameters were couched within two themes: (T3) mentorship as evidence of coping behaviors and (T4) navigating multiple identities in STEM.

(T3) Mentorship as Evidence of Coping Behaviors

Mentorship has often been couched as an important factor for student success, especially for minorities within STEM fields who may have had limited exposure to STEM or STEM professionals. When asked about their experiences with mentorship and having a mentor, many described relationships with faculty members or advisors.

> I try to keep close to different faculties especially. I didn't have necessarily peer mentors, but I have different faculties and academic advisor that I go to, but it was mostly school-related. I would probably call my other friends whom I knew are going through the same stuff, who didn't necessarily go to this school, to talk about the problem they have so that I can reflect from their experience to know how I can navigate… a mentor, it's probably

someone you can look up to and who can guide you. Most of the time, it's someone who has done what you are trying to do. Yeah, I see a mentor in that way – Omar

I feel like as far as mentorship, I guess, and relate to STEM itself, I guess in school, I've had different teachers and stuff, some of whom are more passionate about the field of study that they have taught more so than others. I feel like teachers and professors to a certain extent have been my mentors, but I can't really say that I've had one consistent mentor over a long period of time. It just depends on what I've done, what I've been doing… I feel like a mentor helps you, but it's also someone who's behind you every step of the way, just someone who you can always bounce your ideas off of or how you feel about something off of, someone who always tried to keep you on the right path so to speak, to steer you or to keep you, I don't want to say in line, but just to keep you on the right track. That's what I feel like a successful mentor would do. That's the influence I feel like they'd have over me. – Shyheim

For me, it's [mentorship] a very, almost biblical definition. Similar to discipleship. I think a mentor is somebody that you kind of look up to for guidance, somebody hat's been through the same, similar situations where you've been, or somebody who's in a role that you feel like, one day, you would like to be in a similar role and them helping you kinda, get to that place. Or navigate those spaces that they've been in before. – Judah

All but one of the participants in this study identified instructors or teachers as potential mentors, revealing that students have dual expectations of faculty and instructors, expecting them to essentially act within the capacity of both a mentor and an instructor.

When asked if he had a mentor, Tyrik stated that he was still looking for one, but defined a mentor as: "Somebody that's been through what I've been through and can help me get through it." However, Tyrik also discussed being approached by one of his faculty members and invited to work in a lab doing undergraduate research. It would seem that this faculty member was attempting to act in the capacity of a mentor to Tyrik, however it was unrecognized as Tyrik preferred a mentor with his same racial background who may have been able to better understand some the issues that he faced as an African American.

Participants were asked to further describe if they had ever acted within the capacity of a mentor and what that role looked like as they functioned as a mentor, they often described mentorship more informally.

> I guess not officially, though I definitely keep an open book to anyone. Like whoever has my contact information, just let me know if you need help when you get there, because if I don't know it personally, then I definitely know people who can help you contact a tutor." He further described these relationships stating: "it definitely begins with a friendly conversation. It's typically the – or a friendly peer environment or just like asking them what's your name, major? How's their semester going? – Roy

> I probably wouldn't call it a formal mentorship, but there are students in my programs who are a minority, specifically like the African-American or African descents. They're kind of one year behind me. I will approach them and tell them what to expect and things like that, and maybe share with them some resources. But it wasn't like a formal mentorship, that I was higher, and they are below. It was kind of like friendship in a way. Yeah. – Omar

> I've actually mentored a bunch of students that were in the STEM field. Normally, it starts ... with us being in a similar organization or I meet them playing basketball in one of the gyms on campus and have a conversation. Really kinda hit it off, and decide to meet up for lunch or something, outside of that organization's meeting or something like that. Then we begin to chat, and I just really feel like I can relate to their story or their struggle and just kinda want to help them kind of navigate ... that space, and so we begin to meet up more regularly. It's a very ... personal relationship. I feel like ... vulnerability and transparency are key to any good mentor mentee relationship, but that's also balanced with setting goals or ... reading books together. Different things like that that will help them ... in their career. – Judah

Many associated mentorship with positive social capital, motivation and success. However, mentorship may also be indicative of coping through bridging. Participants in this study had varying perceptions of mentorship, but all described desiring or perceiving a mentor as someone that would advise them on the best practices to navigate the social pressures and social expectations associated with being successful in the STEM environment. The participants in this

study did not express apprehension concerning the assignments or tasks associated with being successful, but instead desired mentorship in making sure that they performed the correct tasks or made the correct decisions necessary to meet their career goals. These statements about mentorship indicate that coping may be occurring as students seek mentorship to help them overcome soft-skill or relational barriers (problem B) in an effort to be able to perform the technical tasks associated with their degree programs (problem A). In addition to the possibility of functioning outside of their preferred problem-solving style, these students are also operating in a culture that is often different from that of their home cultures. Seeking mentorship is therefore an indicator of coping because it requires one to expend extra energy navigating, pursuing and cultivating relationships in an effort to assimilate into the STEM culture and to obtain success in their fields.

(T4) Navigating Multiple Identities in STEM

In addition to their roles as students, participants in this study occupied and navigated multiple roles and identities, as African Americans, as immigrants, as peers, as employees and more. The navigation of these multiple identities, which may necessitate different responsibilities or behaviors can cause inner conflict if or when the responsibilities associated with each role contradict one another. Many participants expressed the belief that their race or ethnicity made it more difficult for them to be navigate the STEM environment.

> I think in a lot of the spaces that I've been in, other than ---, where there were a lot of people in the STEM field, I often found myself as the minority, and I think there's ties where I do feel like I can't necessarily be myself, that I have to change myself to kind of fit in with the group, to relate to them or so that they see me as equal and not as a lesser individual. – Judah

The only difficulty I've had with faculty members, most of them understood my situation. In agriculture, we have stuff that happens all the time. At that time, I had PhDs make it out, or they had a terrible storm that I had to run back and get stuff in, or might be only a certain amount of time that we have a dry week or two and there's certain amount of stuff need to get in the ground, and you don't have time to do certain things. I had a lot of professors that first didn't understand it – Antonio

So in terms of like a career fair, we've had classes ... You know, sessions where we've talked about, in preparation for that, meeting with recruiters and that sort of stuff, like how to present oneself, and how to ... Like certain things, what to say, and coaching yourself, coaching ourselves on what to do. So, I would say that's probably one area in which I've had to feel like I've maybe changed how I normally am to meet a certain ideal. Trying to think of what specifically these people want to hear me say, have specific anecdotes, and strong action words, and making direct, constant direct eye contact, and being very cookie cutter. -Malik

I guess to some extent you do have to change I guess your mindset or the way you approach things, because not everybody may have the positive go ahead, can do attitude, so I think it's one of those things where you have to I guess evaluate the environment and find a way to basically take your ideas and put an interesting spin on it per se, but more so trying to maintain yourself in that manner, but for the most part when going into that type of environment I tend to basically either forget the whole purpose as to why I was there or just end up I guess losing the whole oversight of the entire thing in general, but never I guess you have to conform to something, yes, so. – Roy

Participants in this study described working to assimilate into the STEM culture and the ways in which they sometimes felt disconnected or ostracized from others within the STEM field. Antonio and Judah, both non-traditional students working while pursuing their degrees highlighted the difficulties in navigating spaces as a black man, student and professional. Roy and Malik described changing their behaviors in an effort to make sure that their voices were heard, seemingly forcing them to negate various aspects of their overall identities.

Identifying with the degree program and/or career field that one has chosen is important implications for retention within the field. Although these participants identified as STEM

students, there was seemingly a disconnect between them envisioning themselves as

professionals or as successful STEM students.

> I'd say a successful student would be someone who wants to be there, first of all. Because if you want to be there, then everything you do would not just be something that you're just doing for the sake of it, but actually you want to do it. That shows in how you do your work, how you talk to people, how you act in ... whether it's test, homeworks, project. You take everything more importantly. Someone who is not successful would be like they're just doing it. Oh, I don't care about it. Successful people might have more I need to do this. I want to do this because of what I have ahead of me. They don't have what ... Okay, I'm just doing it for now. I don't care what happens later on – But, being successful in the field, you think about the future. You think about what's going on. Whatever you're doing now, you're doing it for the future so you tend to do it with more seriousness – I'm getting there slowly. – Darius

> I feel like a successful student in the STEM field, obviously they have good grades and good knowledge, but most importantly I feel as though a successful student in the STEM field constantly challenges themselves to absorb all the information in their studies and to constantly be able to apply it and remain passionate about it, to in fact express their passion in STEM by finding new ways or thinking of new ways to apply that information. I feel like I am starting to get a grasp of that, and constantly continue to learn from my experiences and add to my knowledge, and all those things that I feel like would make a successful STEM student. I feel confident to say that I am a student, not necessarily just because of strictly grades or anything like that. I've done well, but also because of just how I continue to learn new things from day to day and learn how everything connects in the STEM field. – Shyheim

Each of the participants in this study described the intersectional identities of race and

gender as well as some of the roles that they held both internal and external to academia,

including memberships in various clubs, providers and more. Of the roles described, race seemed

to be a more prevalent factor impacting the navigation of the STEM environment, however for

the non-traditional students, financial obligations and roles such as provider were also salient.

These identities are often not found in concert among a vast majority of college students and

therefore presented a specific conflict that many faculty were not equipped to handle.

Connecting to the Conceptual Framework

Each of these themes tie into the conceptual model, demonstrating the introspective nature of the participants, their attitudes, values and beliefs (cognitive affect) and how this process influences their behavior (motivation to degree completion) in the environment. As the participants in this study worked to matriculate through their individual degree programs, they often expressed their motivation to succeed despite receiving negative feedback from their environments as it relates to perceptions of inadequacy and their roles as both consumers and purveyors of knowledge. These factors each played a significant role in the expressed identity of the individuals in the study and in the coping behaviors that they employed in an effort to persevere.

Summary

Chapter four presented an analysis of the results of 10 semi-structured interviews and descriptive quantitative data on black identity, academic motivation and problem-solving preferences of African American men currently pursuing STEM or STEM related undergraduate degrees. An analysis of instrument results and interview transcripts yielded four themes that were utilized to address the research questions and problem statement of this particular study. Participants in this study shared similar definitions of mentorship and the desire for a mentor but all indicated a lack of a mentor. Participants also overwhelming described experiences with imposter syndrome accounting for their inability to envision themselves as successful STEM students. Lastly, both international and domestic students shared similar experiences with faculty members and peers within the STEM environment. Recommendations associated with each theme are described in chapter five.

Chapter 5

Conclusion

As discussed throughout this document, this dissertation research study was designed to explore the processes of STEM identity development, academic motivation and problem-solving style of black men pursuing undergraduate degrees in STEM giving voice to this often-overlooked population. Examining specific problem-solving preferences, behaviors and their relationships to motivation and identity, the researcher sought to unmask the commonalities and divergences in the experiences of black men matriculating in undergraduate STEM programs. Therefore, this chapter will commence by reviewing the problem statement, assumptions, study methodology and the conceptual framework. This chapter will conclude with an interpretation of responses organized by research question, discussion of the implications of this data and recommendations for practitioners and future research.

Problem Statement

STEM and agriculture are some of the fastest growing employment sectors within the United States workforce. While significant strides have been taken to mitigate skills gaps between American employers and potential employees, there is still a significant issue surrounding the diversity of persons entering into the STEM and agricultural based fields. Business leaders from throughout the nation are beginning to acknowledge that diversity is an important factor in the success of a company as it contributes significantly to innovation (Hunt, Layton, & Prince, 2014). Accordingly, it stands to reason that diversity within STEM and agricultural education is similarly important. Developing a diverse pool of students is essential to preparing the talent needed to reflect a diverse workforce, which provides variation in thought

and delivers new solutions to the problems of the future (Klunder, 2014). Some of the more direct benefits of greater levels of diversity have been found to be a variety of different personal abilities and experiences that tie directly to positive economic growth (Alesina & La Ferrara, 2005). However, the diversity of students within STEM and agricultural programs throughout the United States has not met, nor kept up with the changing demographics of the nation, leaving in its wake graduates that may not be trained to facilitate relationships within culturally diverse groups (Vincent, Killingsworth, & Torres, 2012).

In addition to the issues surrounding the recruitment of diverse talent into STEM and agricultural fields, exists a disparity in the number of minority students pursuing and attaining degrees within the fields, an issue that can be traced back to problems within the K-12 educational system (Brown et al., 2017). Brown et al. (2017) found that disparities within education have resulted in a lack of science exposure for African American students during a critical time in which most students are deciding their future career trajectories (Brown et al., 2017). This limited access and exposure to STEM coursework and activities compounded with a lack of minority representation within the field can hinder or inhibit the development of a STEM identity and the likelihood of an African American student to pursue and persist a STEM based degree program. Further compounding issues surrounding the number of minority students entering into STEM fields, is a gender disparity among minorities, particular as it relates to African American males. Given these factors, it can be inferred that this population often faces multiple barriers to educational achievement and have limited opportunities to pursue and complete STEM degrees.

Current theory and practice often overlook the intersectionalities of black male identity and much of the literature surrounding this population is written from a deficit-perspective,

overgeneralizing often negative characteristics of those with memberships in this group (Woods-Wells, 2016). Furthermore, much of this literature does not account for the critical consciousness of race and social justice issues related to race which can be remedied through the usage of critical theories such as critical race theory. The approach within this study creates a model that incorporates both cognitive, social and environmental factors that influence the perceptions, behaviors and strategies that black men employ when developing STEM identities and persisting within STEM degree programs.

Methodology

As described in chapter 3, this was a phenomenological study which explored the processes of STEM identity development, academic motivation and problem-solving preferences of black men pursuing undergraduate degrees in STEM. Qualitative methods were used within this study to gather information describing participant experiences, relying upon interview data and quantitative data was used descriptively.

A total of ten semi-structured interviews were conducted with undergraduate students pursuing undergraduate degrees in STEM and who self-identified as African American males and consented to participate in the research study. With the exception of three interviews that took place via video-conference, all interviews took place in person. Participants were asked to complete the academic motivation survey, multidimensional inventory of black identity and Kirton's Adaption – Innovation (KAI) inventory to assess their motivation towards degree completion, black identity subscription and problem-solving preference.

Study Summary

This study was influenced by three *a priori* assumptions that were supported by the literature and aligned with the research questions. These assumptions provided the grounding framework for exploring the processes of STEM identity development in relationship to academic motivation and problem-solving preference. Similarly, the interview protocol was developed in congruity with these assumptions. The assumptions within this study were:

- African American males are often depicted as aggressive, hypersexual and violent or as gang members, criminals or professional athletes. In response to this, some work to cultivate scholarly identities as an act of resistance to fulfilling the stereotype (Rogers & Way, 2016).

- Double-consciousness requires African American males to simultaneously work within two cultures to negotiate various identities and barriers to social capital development (Woods-Wells, 2016).

- The development of professional identity among males is influenced by cognitive factors in addition to influences from the social environment (Anderson et al, 2017).

Each of these statements supported the development of the study research questions and foundation within the literature and were supported by participant responses.

Purpose & Research Questions

The purpose of this research study was to utilize a cognitive lens to examine experiences and factors impacting the retention and persistence of African American men in STEM degree programs. STEM and racial identity development will be explored in relationship to cognitive problem-solving preference, performed behaviors, social interaction and academic motivation.

Utilizing the concept of critical race theory, this research seeks to provide culturally rich data about the lived experiences of African American male students as they develop and unite their individual STEM identities and racial identities as they pursue STEM and agricultural degrees.

The intended outcomes of this study included highlighting the unique experiences of African American males in pursuit of a STEM degree as they navigate multiple identities and problem solve in order to overcome real or perceived barriers to degree completion. The guiding research questions are as follows:

1. How does one's expressed behaviors compare to one's problem-solving style, academic motivation and subscription to black identity?

2. Are African American males feeling a sense of belonging within STEM degree programs?

3. How are coping behaviors being evidenced among African American men within STEM degree programs?

Interview data from participants in this sample of black men was used to underscore their experiences specifically addressing differences in problem-solving preference, motivation and perception of motivation, identity and perception of identity and to offer insight into behaviors and expressed identity as a by-product of these internal negotiations. As described in chapter four, four main themes emerged from the data analysis. The themes, listed below, provide the framework that will guide the discussion for implementation and recommendations that will be described in this chapter:

1. Motivational factors and challenges to attrition

2. Experiences impacting sense of belonging

3. Mentorship as evidence of coping behavior through bridging

4. Navigating multiple identities in STEM

Participants expressed a common belief that they would accomplish their goals and identify more with STEM upon developing various skills that they associated with success in STEM. The majority of information shared was related to self-reflection, perceptions of success and experiences within the learning environment. Participants also reflected upon race and perceptions of race that they believed impacted or influenced their behaviors and interactions within the learning environment.

The conceptual framework for this study accounted for cognitive function, motivation and race in addition to expressed identity, behavior and environment. The interplay between these theories described a reciprocal relationship between environmental factors and behaviors and the cognitive processes that influence STEM identity development, academic motivation and problem-solving preferences with respect to critical race theory. The impetus behind the combination and usage of these variables are that STEM identity development among those within this group can be better understood by seeking to understand how they perceive and comprehend problem-solving within STEM, express their identities as black men and examine their behaviors and performed behaviors as a result of issues or perceptions of their environments.

The cognitive function schema, combined with the organismic socio-behavioral perspective and critical race theory provided a structure for the themes that are described within this study. Theme one, motivational factors and challenges to attrition, more closely aligns with the introspection of the OSBP model and cognitive affect of the cognitive function schema which describe needs, values, attitudes and beliefs via motive. These factors impact behavior or coping and impact one's perception of environment, culture and opportunity. Theme two, experiences

impacting a sense of belonging, focused on one's expressed identity and interpretation of cognitive resources, knowledge skills and experiences, interacting with one's environment. Theme three, mentorship as evidence of coping behavior and theme four, navigating multiple identities in STEM more closely aligned within cognitive effect, demonstrating the relationship between interaction or preferred style and level, expressed identity and behavior. Each of these themes considers facets of critical race theory as participant perceptions and behaviors may have been directed by knowledge gained experientially either personally or through the observation of others (Woods-Wells, 2016).

Critical race theory in particular denotes the inherence of race and racism and its pervasiveness within society. Given these factors, the cognitive function schema and organismic socio-behavioral perspective provide complimentary explanations and process for motivation and the cognitive processes associated with identity development, including self-awareness, behavioral changes or posturing and changes in motivation. Providing space for understanding the experiences of these participants and the impact that these experiences have had on their STEM identity development and motivation to complete their degrees is important to furthering diversity and inclusion initiatives and implementation. Participants often discussed being viewed through a deficit perspective and described feeling as if others questioned their scholarship and deservingness to be within their institutions or within their fields. These perceptions were supported by previous research studies describing the deficit perspective through which many minority students are viewed (Garvin-Hudson & Jackson, 2018; Atwater, 2000). Initiatives such as climate surveys within institutions of higher learning are a great start towards creating a space for dialogue around these issues and for the creation a space strategy development to combat reports of injustice within the educational space.

Significance

There is an increased need for both diversity and STEM trained employees entering the workforce. In a 2014 report published by the STEM Food and Ag Council of STEMconnector found that the creation of new jobs in this field along with the mass exodus of current agricultural professionals has contributed to an average of 11,600 monthly job postings in the field of agriculture and approximately 34,000 people were hired within these field from January to August of 2014 (STEM Food and Ag Council, 2014). A 2015 CNN Money report found that America currently has millions of job openings, more than any at other point since the year 2000. While this is indicative of positive economic growth, it is also a reason of concern because it is demonstrative of a significant skill gaps and shortages among employers and potential employees in the U.S. workforce (Gillespie, 2015). This study contributes to closing the skills gap by determining perceptions of barriers towards degree attainment and retention in the sciences. An understanding of these issues can be utilized to better develop strategies for developing and upskilling workers to enter into the STEM economy.

A skills gap is a term used by employers and policymakers to describe the lack of basic skills necessary for future employees, while a skills shortage refers to the lack of job-related skills associated with particular occupations, such as occupations within STEM (Cappelli, 2015). Technical colleges and industries have begun to develop closer partnerships to address the issues with the skills gap. In the 1990's the federal government instituted workforce training programs and initiatives that transformed the roles of community colleges to support the changing workforce and economy. This significant change, allowed community colleges to better serve the local community by better facilitating partnerships with local industries that allowed them train

and recruit local talent for the available jobs (Yarnall, 2014). These partnerships allow new and dislocated workers to help both citizens and businesses within the smaller community increase their human capital, enabling them to better compete for the jobs of the present and the future (Karas, 2013). While these are significant strides towards closing the skills gap, the growth of the number of minority workers in STEM and agricultural fields, specifically those of African American descent has not been reflective of their presence in the overall United States, where they represent approximately 13.4% of the population (U.S. Census Bureau QuickFacts: UNITED STATES). Understanding how people from underrepresented groups experience, identify themselves among, and cope within STEM and agricultural degree programs is complex and encompasses a number of various factors. Critical race theory provides a unique lens to capture this information from the perspective of members within a marginalized group through the telling of counter narratives. The information derived in this study will help meet the needs of our growing workforce by providing information about the barriers hindering minority entrance or persistence in STEM and information that can inform university recruitment and retention strategies.

This information derived from this study provides a unique insight into the ways that black men negotiate their identities and navigate their experiences within STEM in their own voices and from their own perspectives. It will also provide recommendations and strategies that can be implemented by black men to help overcome barriers and develop stronger STEM identities by sharing the successes of other black men in STEM.

Limitations

This study utilized a qualitative research design that was informed by descriptive quantitative data. While all efforts were made to ensure reliability and correct interpretation of data, there are still some limitations that were inherent in this study. The researcher identifies as an African American woman and therefore holds certain biases. In addition, the data collected is self-reported and the researcher had no other resources for evaluating STEM or ethnic identity or relationships outside of student membership or participation within student groups or committees. Additionally, this study utilized a small group of participants, within a field that is not highly diverse and most participants were from predominately white institutions, which may limit the transferability of results to students attending minority serving institutions. However, as with many studies focused on historically marginalized groups, it is important to draw inferences from small, subjective, qualitative data in order to address and critique dominant paradigms. This requires selecting methodologies that correspond to the interest of particular social groups, as was done in this study (Hill-Collins, 2000).

Discussion

During the course of this study, colleges and universities have been rocked with scandals concerning the admission and preparedness of students entering into their respective institutions. Many of those embroiled in the scandal were affluent non-minority students who attempted to gain admission into higher education through ill-gotten means (Yan, 2019). Although few, if any minority students were identified in this scandal, it reveals the hypocritical attitudes and beliefs that are often projected onto minority students who described their university admission and knowledge being questioned by non-minority adults and peers. The perception and realization of

these issues have a strong implication for better understanding the experiences of black men in STEM. This study does not state that issues with STEM identity development only occurs within black men.

The participants within this study have each had unique experiences with STEM identity development that were evidenced within their narratives. The experiences of these young men provided by these counternarratives contradict the negative assumptions often held about African American men, including their apathy towards education and criminality. Instead, these counternarratives highlight their individual strengths, motivation and tenacity to succeed despite racism and other barriers that have the potential to derail them in their degree programs. As a result of their individual experiences, each of them has different ideals associated with STEM identity and success. For Shyheim, a successful STEM student was associated with obtaining satisfactory grades and continuing to learn and apply new information, or being more innovative in seeking ways to manipulate the environment. While for Xavier, it was associated with garnering internships, mentorships and employment opportunities or working more adaptively within the confines of the environment. Despite differences in the ways in which students viewed STEM identity and success, they have each entered and persisted within their fields thus far. As such, this discussion serves to further extrapolate the counternarratives about the ability of black men to succeed within higher education and specifically within STEM degree programs.

Research Question 1: How does one's **observed** behaviors compare to one's problem-solving style, academic motivation and subscription to black identity?

Based upon the conceptual framework, one's observed behavior is cognitively evaluated and regulated through the introspection of one's expressed identity. One's expressed identity

includes, but is not limited to, his cognitive effect (problem-solving style and academic level), his cognitive affect (subscription to STEM and Black identities), and his cognitive resources (knowledge retained that will help him reach his goals). The academic motivation to engage in STEM-oriented activities (observed behavior) is a product of his interpretation of how the environment accepts and values his expressed identity based on the environmental feedback he receives.

Participants in this study overwhelmingly identified as more innovative with a mean score of 100, but it should be noted that this is similar to the average KAI score for men, which is 98 points. The behaviors of these participants corroborated their designations as slightly more innovative than the US population mean. Additionally, they expressed the need to employ coping behaviors within three areas: cultural, problem-solving, and expertise. Participants overwhelmingly described coping culturally and with expertise which impacted their coping within groups based upon problem-solving preference. Coping during problem solving was evidenced within the roles that were taken by students. The experiences with coping are also grounded within the tenets of critical race theory as instructors acted as gatekeepers of knowledge, deciding upon which information was valuable or credible – often invalidating the knowledge of the students if it were different or contrary to their knowledge bases. Incidences such as these create a climate of exclusion through the invalidation of student personal knowledge which has the potential to enhance learning. The current success and persistence of these participants aligns with the assumption associated with A-I theory that indicates that a quarter of a standard deviation towards innovation is the average of what is needed to break through a social barrier such as language or socioeconomic status (Kirton, 2013). Data from this research question align with the sc as cognitive function/expressed identity are influence by

environmental feedback or social effect causing one to interpret or create meaning via motive. This process of coping continues based upon a students' motive or desire to succeed, but also impacts the student's sense of belongingness as they interpret the role and value of their expressed identity based upon feedback from the environment.

Implications for Practice

KAI provides a cognitive lens for understanding the diversity in problem-solving preferences and can also be utilized to provide a better understanding of group or team dynamics. As one is forced to problem solve in ways that are vastly different from their own problem-solving style, they must cope or adapt to function outside of their preferred styles. This process is often psychologically taxing but bolstered by one's motive to solve the issue at hand. In addition to coping resulting from problem solving, coping can also result from issues associated with communication and cultural norms. The dismissal of, or failure to acknowledge unconventional knowledge, culture or experiences operationalizes concepts of colorblindness, further demonstrating the need to further explore issues with diversity as it relates to thought, cognition and the acceptance of diverse perspectives. The triadic reciprocal nature of the conceptual model provides information that allows one to better understand the importance of the relationship between expressed identity and environment in eliciting pro-social and pro-STEM behaviors, highlighting the importance of creating affirming STEM environments that affirm both personal and cultural identity. The product of these interactions, or the persistence in STEM is a result of the ways in which students interpret responses to their identities within their environments, a process which is also viewed through a critical race lens accounting for the racialized perceptions often associated with their identities as black and male. The usage of instruments such as the

KAI, MIBI and AMS provide an insight into cognitive and cultural factors impacting black male identity. The results of these assessments provide language that can allow black men to better articulate their identities and the intersectionalities associated with their identities.

Recommendations

Adaption-Innovation theory and KAI should be more prominent within discussions surrounding diversity and inclusion, as well as included as a salient variable in future research. This theory, provides information that can further conversations about ethnic diversity and inclusion by providing a layer of intersectionality that has yet to be fully explored. It is important to acknowledge the role of environmental feedback and social effect on the ways in which students create meaning and how that validates or invalidates their expressed identity and cognitive processes. A greater understanding of these cognitive processes and power dynamics between students and faculty members can help create a more inclusive culture of belonging, minimizing the areas in which coping is occurring. Additionally, knowledge garnered by individual student experiences or cultural should be welcomed as expanding the discourse of scholarship in the subject area. In an effort to create a more inclusive culture, it is imperative to create and support spaces of affirmation for black male students to share their experiences and be provided with structured supports to overcome real or perceived obstacles.

Research Question 2: Are African American males feeling a sense of belonging within STEM degree programs?

Theme 1: Black in Science & Challenges of Attrition

For students whom identify as black or African American and whom are also involved in STEM, challenges towards degree completion such as inadequate high school academic preparation and access to resources are compounded by experiences with racism, isolation and a lack of support on the college campus. Additionally, a lack of financial capital, the "weed-out" culture that is has been historically present in many STEM disciplines has not created a culture that supports student success and disproportionately impacts African American students (Green et al., 2018).

Challenges that participants in this study described included the perception of being viewed through a deficit perspective and the desire to connect with faculty to develop more meaningful relationships that will allow faculty to better understand and account for student issues that may impact retention. This data supports the findings in the literature as it further describes the interactions or role of environment on one's cognitive affect and subsequently exhibited behaviors. Internalized beliefs and needs motivated participants to persist within the environment, adapting as necessary to procure the skills necessary to endure. The process of interpretation or meaning making is one that is powered by motive. As students receive feedback from the environment, they must constantly interpret or reinterpret the actions of themselves and those within their environments, how they impact their needs, values, beliefs, affirm or deny their knowledge, skills, and experiences, and how these all interact with their preferred style and potential level; all of which are factors salient to expressed identity within the conceptual model.

Students desired to develop relationships with faculty members but many were unable to do so. Participants from PWI's expressed difficulty forming relationships with their faculty, while students from the HBCU's felt more comfortable approaching faculty, but also described difficulty connecting with them on some issues, especially if they were non-traditional or had financial difficulties that could hinder their academic progress. International students also expressed similar concerns about developing relationships with faculty and even approaching them to ask questions. They, like the domestic students within this study were concerned with appearing inadequate for the degree program if they asked certain questions and also described being overlooked or feeling as if they were not viewed as intelligent by their instructors. These factors lean towards the critical race theory tenet of colorblindness as African American students face significantly more challenges to excelling in education, challenges that are both unnoticed by white students or faculty and are issues that they do not contend with. This also draws upon the critical race tenet of race as a social construction. As a result of inequitable opportunities, African American students have been often negatively stereotyped, which may cause them struggle in some areas, however their struggle is often viewed as a collective inability to succeed rather than an individual challenge (Zamudio, et al., 2011).

Implications for Practice

Woods-Wells (2016), posited that recognizing the diversity among black men and their individual contributions can facilitate better social interactions and help to build more inclusive working environments (Woods-Wells, 2016). Based upon the experiences of participants in this study, the data within this study indicates that social capital and relationship development is an important motivational factor to continuing degree completion. Introspection, interaction and

interpretation as described in the conceptual model work together describing the on-going process of self-analysis, influence of group dynamics and the creation of meaning associated with each of this processes in the development a STEM identity (product). The resulting product or STEM identity is viewed through a critical race lens based upon societal norms and standards which are often grounded in practices of white supremacy. The historical and racialized experiences of black men as a group in conjunction with their unique experiences within the STEM environment describe why African American men continue to be underrepresented within STEM.

Recommendations

Those working with students with memberships in marginalized groups should work to facilitate interactions and spaces for exchanges between students and faculty members. These spaces can be created in less-structured settings with faculty taking a leading role in approaching students with memberships in marginalized groups to learn their interests and to share opportunities, building trustful relationships between themselves and the students.
Faculty must also work to be more aware of the intersectional issues in student background and experiences that impact their educational experiences including perceptions of power and power-distance. Future research should seek to identify faculty perceptions of barriers or challenges to minority student retention and work to bridge the gap between the perceptions of students and faculty.

Theme 2: Experiences Impacting Sense of Belonging

The sustaining and development of relationships were a common theme that continued to support multiple themes. Although participants identified the salience of relationships, they also described negative experiences with faculty and peers that impacted their sense of belonging. Several participants described imposter syndrome and experiences with faculty or peers questioning their intelligence and assuming that students gained admission to university based upon quotas associated with affirmative action. This indicated that the environment may not be as inclusive of student culture as students attempt to navigate the environment, interpreting various incidents through past and ongoing experiences (cognitive resource) and adjusting their behaviors in an attempt to be better accepted within the culture of the environment (Kirton, 2013). Students also described fewer extracurricular interactions when entering the later years of their program, indicating that there may be a decrease in the availability to seek or engage with external support structures. The participation of students in these extracurricular activities describe the creation of a counterculture that both supports their identities and scholarship. These spaces may or may not be culturally specific, but allow for the student receive positive environmental feedback and support for them to continue within the STEM environment. The inability for students to continue frequent participation within these groups during the latter years of their programs, coupled with the negative experiences within the larger context of their degree programs may have negative impacts on the continued interpretation STEM identity development process as described by the conceptual model.

Implications for Practice

Garvin-Hudson & Jackson, 2018; Atwater, 2000 posited that African American students are often viewed through a deficit perspective. This statement was corroborated by the participant experiences shared within this study. Understanding these factors and the unconscious biases associated with these perspectives are critical to the work of faculty and peers to effectively challenge their own biases and create a better learning environment. This theme highlights the importance of considering the relationship between interaction and interpretation. If and when African American men feel valued, they have an increased sense of belonging which supports or increases interactions.

Recommendations

Faculty should intentionally provide increased opportunities for relationship development and seek out opportunities to assess and combat their own conscious or unconscious biases. This can be done by participating in trainings or workshops related to the development of inclusive pedagogies and intercultural engagement as a reflective practitioner. Furthermore, these types of training and development programs should be mandatory each year and a required training for all university professionals. Additionally, extracurricular activities are functioning in the role of external support structures and participation in these activities should be encouraged and supported by faculty members. Future research should address the implementation and effectiveness of unconscious bias trainings and culturally relevant pedagogy in addition to the salience of extracurricular participation.

Research Question 3: How are coping behaviors being evidenced among African American men within STEM degree programs?

Theme 3: Mentorship as Evidence of Coping Behaviors

Participants within this study often defined mentorship in similar ways, describing mentorship as a relationship that provides guidance or a sounding board for navigating issues associated with their degree programs or other facets of life. However, all conflated mentorship with expectations that they had of their faculty members. Participants within this study most often described desiring or seeking mentorship in order to help them to navigate the socio-political structures associated with their ethnicities and navigating within the STEM field. Although participants did indicate sometimes having challenging coursework, they were overall confident in their abilities to succeed with the assignments. These factors highlight this type of mentorship as a coping strategy to learn how to better navigate the STEM environment. African American men are often viewed through a negative lens and have a perceived apathy for education. These results indicate that African American men were exhibiting coping behavior as their expressed identities and potential level (introspection) were seemingly viewed as in conflict with one another when viewed through a critical race lens. This perception of identity conflict and the self-analysis (introspection) associated with it produced imposter syndrome as students viewed their successes and abilities through a standard associated with whiteness or critical race theory as depicted within the conceptual model.

Implications for Practice

Based upon participant understandings and desire of mentorship, faculty members and advisors should work to better delineate roles or create programs to match students with mentors. Understanding that faculty members are most often viewed through a dual lens as both mentors and instructors should inform the ways in which faculty members interact with students. This view of mentorship and the responsibility of faculty as mentors may also be indicative of a lack of willing or available mentors for minority men in STEM. This theme highlights the importance of the relationship between introspection and interpretation. Instructors and mentors are uniquely positioned to develop students as leaders through the creation of a space for capacity building related to a students' processes of introspection and interpretation.

Recommendations

Universities should develop and establish university wide mentoring programs to train faculty members on how to mentor students and to provide students with opportunities for mentorship. Faculty members should also work to better understand the socio-political issues associated with navigating a system influenced by racism as a minority in STEM. Future research should explore the context in which informal mentor-mentee relationships are formed. An understanding of these relationships may provide better information about the structural supports that students are seeking and provide an understanding of student perceptions of more specific topics related to navigating the STEM environment.

Theme 4: Navigating Multiple Identities in STEM

Participants within this study described straddling multiple identities simultaneously and working to assimilate into STEM culture. Their individual identities as immigrants, students, non-traditional students, mentors and black men were often viewed to be in conflict with one another as the identities they embodied were not commonly found among those who currently identify as STEM students or STEM professionals. These factors also gave bearing to the students lack of identification as successful STEM students. Expressed identity has a significant bearing on one's interpretation or learning of an environment. Based upon these factors within the conceptual framework, participants experienced the world differently based upon various expressed identities, which informed the ways in which they interacted within the STEM environment and accounted for the ways in which they were able to visualize themselves in the STEM field. Critical race theory describes this intersectionality of identity and the ways in which white supremacist thought can impact various facets of identity differently (Delgado & Stefancic, 2017). While men as a gender may be more likely to attain certain status or have access to certain privileges, the intersection of race may limit this access to black men. In terms of education, this my present itself as inequitable access to quality K-12 education or ascription of learning or behavioral issues that further negatively impact higher education experiences. The standards by which participants hold themselves (introspection) are often associated with privileges of whiteness such as access to resources and capital. Similarly, the ongoing interpretation of the STEM identity is continually impacted by one's social interactions which do not always affirm the STEM identities of African American men.

Implications for Practice

The results in this study demonstrate the need for recognizing the intersectionality of those within STEM. Although STEM is traditionally a more quantitative field of work, faculty members would benefit from the incorporation of social science practices that account for diverse perspectives and understandings. This would require understanding the many shared background attributes of black students and their experiences without overgeneralizing those attributes to the greater population of black students. Faculty members should also recognize that many of these students may be the first in their communities to pursue a STEM degree and provide appropriate and timely feedback to students to help them fully realize their STEM identities. Providing appropriate and timely feedback to students will allow them to better build their confidence, envision their successes and better connect to and develop a strong STEM identity. This theme highlights the relationship between introspection and interaction. When African American men feel that their identities are contributing to goal attainment, they find congruence between themselves and their behaviors, reducing role conflict and leading them to engage in more affirming STEM activities.

Recommendations

Faculty should be required to assess their course syllabus and content delivery to include diverse practices and perspectives to help ensure that students can visualize themselves as being successful in STEM fields. Faculty members should also provide timely feedback on student assignments and availability for discussion about student STEM interests and goals to further delineate the ways in which their unique experiences can benefit the STEM fields. Future

research should seek to deconstruct learned biases or misconceptions in STEM and assess the applicability of culturally relevant pedagogy within undergraduate STEM education.

Final Conclusions

This study utilized a cognitive-behavioral approach to understanding the ways in which African American men enrolled in undergraduate STEM degree programs develop a STEM identity and the roles of motivation and problem-solving preferences on this process. This study also included a critical race lens, to account for the present and historical influences of race and the perceptions of race on the development of STEM identity. To that end, counter-narratives about the experiences of black men in STEM were provided to contradict negative stereotypes perpetuated about those with membership within this group. This study facilitated a better understanding of the real and perceived barriers to STEM identity development and persistence in the field including a lack of mentorship to assist students in navigating socio-political climates, the need to prove oneself as deserving of entrance into a STEM program and unconscious biases and lack of cultural awareness of instructors. Persistence in the STEM fields were enhanced by both positive and negative motivating factors such as: cultural differences, finance, philanthropic desire and mentorship.

While race was not a prevailing factor that participants viewed as negatively impacting their experiences, they did acknowledge that it had in some ways colored the ways in which they were perceived by others, in accordance with the tenets of critical race theory. Critical race theory allows research to better articulate the issues impacting marginalized populations, however, student participants may have also been operating within a paradigm of colorblindness, viewing some of their racialized experiences as normative STEM experiences. Motivational

factors were apparent in participant narratives as they described coping to overcome issues to degree attainment. These coping strategies as evidenced in the cognitive function schema in conjunction with the organismic socio-behavioral perspective and critical race theory work together to better describe the story of black men in STEM degree programs.

Overall, this study helped to increase a growing body of literature about increasing diversity in STEM and filled a gap specifically related to increasing the number of black men in STEM degree programs, a group that has not been well explored. It also provided a cognitive lens through which to further explore diversity. The results from this study can aid in the development and implementation of better inclusion and retention strategies to meet the unique needs of men with black men in STEM.

Recommendations for Future Research

The results of this study have implications for both educational and professional organizations that desire to increase minority participation, better inform practices of inclusion and foster a sense of belongingness. Men pursuing undergraduate degrees in STEM, who self-identified as African American, and who agreed to participate in this research study were targeted for participation. Processes of STEM identity development are not only exclusive to black men and challenges associated with STEM identity development among other minority groups may produce striking results and valuable insight for the STEM identity development process. Additionally, repeating the study with a larger study group or targeted to one particular college or university may provide more specific and generalizable data. Finally, it is imperative that continuing research seeks to understand the black male experience within education and the role of race in relationship development and opportunity structure within higher education.

Future research should seek to address:

- ▫ Deconstructing learned biases or misconceptions in STEM

- ▫ Identifying faculty perceptions of barriers or challenges to minority student retention

- ▫ Bridging the gap between the student perceptions of barriers and faculty perception of barriers.

- ▫ Assessing the applicability of culturally relevant pedagogy within undergraduate STEM education

- ▫ Impetus and formation of informal mentoring relationships

- ▫ Effectiveness of current inclusivity and unconscious biases trainings

Summary

This chapter reviewed the impetus for this research and *a priori* assumptions supporting it in addition to providing a brief overview of the study methodology and conceptual framework. This chapter also includes an interpretation of themes resulting from this study, study implications and recommendations for future research.

Overall, this study served to provide information to fill a gap in the literature about the processes of STEM identity development among African American males pursuing STEM or STEM related undergraduate degree programs. Chapter one began with an overview of the issues surrounding diversity in STEM and the need for the inclusion of more diverse persons in the STEM pipeline. Chapter two provided background information and a literature review about black men in STEM and the prevailing factors that may inhibit entrance and retention within the STEM field. Chapter three provided an overview of methods utilized in this study and chapter four provided an analysis and results of data. Chapter five concluded this study by discussing study conclusions, implications and recommendations for future research.

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Appendices

Appendix A: IRB Approval Letter

VT VIRGINIA TECH

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-3732 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: January 7, 2019

TO: Curtis R Friedel, Chantel Yvonne Simpson, James C Anderson II

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)

PROTOCOL TITLE: A Mixed Methods Case Study Investigating the Experiences with STEM Identity Development and Problem Solving Preferences of Gifted African American Men

IRB NUMBER: 18-507

Effective January 4, 2019, the Virginia Tech Institution Review Board (IRB) approved the Amendment request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

https://secure.research.vt.edu/external/irb/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As: Expedited, under 45 CFR 46.110 category(ies) 6,7
Protocol Approval Date: August 27, 2018
Protocol Expiration Date: August 26, 2019
Continuing Review Due Date*:   August 12, 2019
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
An equal opportunity, affirmative action institution

Appendix B: *A priori* Assumptions

1. African American males are often depicted as aggressive, hypersexual and violent or as gang members, criminals or professional athletes. In response to this, some work to cultivate scholarly identities as an act of resistance to fulfilling the stereotype (Rogers & Way, 2016).

2. Double-consciousness requires African American males to simultaneously work within two cultures to negotiate various identities and barriers to social capital development (Woods-Wells, 2016).

3. The development of professional identity among males is influenced by cognitive factors in addition to influences from the social environment (Anderson et al, 2017).

Appendix C: Participant Recruitment Invite

Recruitment Announcement/Script

Are you an African American mand pursuing an undergraduate degree in Science, Technology, Engineering and Math (STEM), agriculture or a related field?

If so, I am interested in hearing from you! My name is Chantel Simpson and I am a doctoral candidate at Virginia Tech. I am working to complete my dissertation research and I am looking for study participants who are willing to share experiences they've had with identity development, academic motivation and problem solving while pursuing their academic degrees.

Your participation would require a minimum time commitment of 30 minutes, and a maximum of 2 hours over a 4-week time period. The phases of data collection will be as follows:

1. Online survey of Black Identity and Academic Motivation *(30 minutes)*
2. Online preferred problem solving style inventory *(10 minutes)*
3. In-person or Virtual audio-recorded interview *(60 minutes)*

The first twenty participants to complete the black identity and academic motivation survey and who also meet eligibility criteria listed above will be contacted to move forward into optional phases 2 and 3 of the research of the study as listed above. Therefore, you may or may not be contacted to continue participating in the study beyond the completion of the online survey. If you are not selected to continue beyond the first phase, your contact information will be removed from my records. Nevertheless, your participation at all phases is voluntary and will be kept strictly confidential.

Interested?
Please complete the online survey of Black Identity and Academic Motivation, also, consisting of a demographic survey at the following link:
https://virginiatech.qualtrics.com/jfe/form/SV_1NQfK0Cd7TVwk1D

What if you have questions about this study?
Should you have any questions about this study, you may contact the primary researcher Chantel Simpson at cysimpso@vt.edu / (336) 937-5753, or the research advisors Dr. Curt Friedel at cfriedel@vt.edu, or Dr. James Anderson at jcanderson@uga.edu

Should you have any questions or concerns about the study's conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the VT IRB at irb@vt.edu

Appendix D: KAI Recruitment Invite

Inventory Recruitment Announcement/Script

Thank you for completing the Multi-dimensional inventory of Black Identity, Academic Motivation and demographic questionnaire and agreeing to be contacted as a potential study participant. Based on your responses to the initial questionnaire, you are invited to take the Kirton's Adaption-Innovation Inventory. This inventory should take between 5-10 minutes to complete. Upon completion of this inventory, you will be contacted regarding the status and next steps of your participation in contributing to the study.

To continue with this study, please click on the link below to provide electronic consent.
Consent to Participate in Kirton's Adaption Innovation Inventory

After which you will receive two follow up emails that link to the inventory and an invite to participate in a focus group session. Please expect the emails from the following individuals:

 Kirton's Adaption-Innovation Inventory - *Email to come from the research advisor, Dr.*

Curt Friedel (cfriedel@vt.edu) or Chantel Simpson (cysimpso@vt.edu)

Risks and Benefits
There are no known risks to participating in this study. Participation in this study is voluntary and you may choose to leave the study and terminate your participation at any time. Please note that although your participation is immensely appreciated in furthering the body of knowledge in this area, you will not be compensated for your participation in this study.

Confidentiality
Your name will be kept confidential with the use of a pseudonym. Accordingly, any research data shared publicly and/or published will be done using a pseudonym. It is possible that the Institutional Review Board (IRB) at Virginia Tech will view this study's collected data for auditing purposes. The IRB is responsible for overseeing the protection of human subjects who are involved in research.

What if you have questions about this study?
Should you have any questions about this study, you may contact the primary researcher Chantel Simpson at cysimpso@vt.edu / (336) 937-5753, or the research advisors Dr. Curt Friedel at cfriedel@vt.edu or Dr. James Anderson at jcanderson@uga.edu

Should you have any questions or concerns about the study's conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the VT IRB at irb@vt.edu.

Appendix E: Interview Recruitment Invite

Interview Recruitment Announcement/Script

Thank you for your participation Kirton's Adaption-Innovation Inventory. Your completion of this inventory has made you eligible for participation in the final phase of the research study, your participation in an interview. The purpose of this interview is to further describe your experiences with identity development, problem-solving, decision-making and overcoming barriers as an African American male in a STEM or STEM related degree program.

I look forward to speaking with you about your educational experiences in this interview. Just as a reminder, the interview will last approximately one (1) hour and will be audio recorded.

To better schedule the date and time for the interview, please confirm your availability via Doodle Poll for the **dates/times listed below that work for your schedule between the dates of December 1 and January 31**. I will confirm the date and time for the interview within a week of receiving your availability. Please note that I have attached a consent form to this email for your review. Please review the form prior to the interview session. I will request your verbal consent to this form prior to the start of the session.

[Interview Availability](#)

Risks and Benefits
There are no known risks to participating in this study. Participation in this study is voluntary and you may choose to leave the study and terminate your participation at any time. Please note that although your participation is immensely appreciated in further the body of knowledge in this area, you will not be compensated for your participation in this study.

Confidentiality
Your name will be kept confidential with the use of a pseudonym. Accordingly, any research data shared publicly and/or published will be done using a pseudonym. It is possible that the Institutional Review Board (IRB) at Virginia Tech will view this study's collected data for auditing purposes. The IRB is responsible for overseeing the protection of human subjects who are involved in research.

What if you have questions about this study?

Should you have any questions about this study, you may contact the primary researcher Chantel Simpson at cysimpso@vt.edu / (336) 937-5753, or the research advisors Dr. Curt Friedel at cfriedel@vt.edu and Dr. James Anderson at jcanderson@uga.edu

Should you have any questions or concerns about the study's conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the VT IRB at irb@vt.edu

Appendix F: Interview Consent

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants
in Research Projects Involving Human Subjects

Title of Project: *A Mixed Methods Case Study Investigating the Experiences with STEM Identity Development and Problem Solving Preferences of Gifted African American Men*

Investigator(s):   **Chantel Simpson**   **cysimpso@vt.edu (336) 937-5753**
                          Name   E-mail / Phone number

                          Curtis Friedel   **cfriedel@vt.edu (540) 231-8177**
                          Name   E-mail / Phone number

I. Purpose of this Research Project

Your completion of the KAI inventory has made you eligible for participation in the final phase of the research study, your participation in an interview session. The purpose of this interview is to further describe your experiences with identity development, problem-solving, decision-making and overcoming barriers as an African American male in a STEM or STEM related degree program. The results from this study will be used for a dissertation and may also be used for publication. This interview session will be comprised of approximately 25 one-on-one or individual sessions with African American men ages 18 and over who are enrolled in a STEM or STEM related degree program.

II. Procedures

Should you agree to participate, you will be asked to participate in one 60-minute audio-recorded interview session that will ask questions identity and belonging as an African American male with a STEM or STEM related degree program.

This interview session will take place on the campus of Virginia Tech or University of Georgia at a location TBD or virtually using conferencing software.

III. Risks

There are minimal risks to participating in this study. Participation in this study is voluntary and you may choose to leave the study and terminate your participation at any time.

IV. Benefits

Please note that although your participation is immensely appreciated in further the body of knowledge in this area, no promise or guarantee of benefits has been made to encourage you to participate.

V. Extent of Anonymity and Confidentiality

Your name will be kept confidential with the use of a pseudonym. Accordingly, any research data shared publicly and/or published will be done using a pseudonym. It is possible that the Institutional Review Board (IRB) at Virginia Tech will view this study's collected data for auditing purposes. The IRB is responsible for overseeing the protection of human subjects who are involved in research.
"At no time will the researchers release identifiable results of the study to anyone other than individuals working on the project without your written consent".

VI. Compensation

No compensation will be provided for participation in this research study.

VII. Freedom to Withdraw

It is important for you to know that you are free to withdraw from this study at any time without penalty. You are free not to answer any questions that you choose or respond to what is being asked of you without penalty.

Please note that there may be circumstances under which the investigator may determine that a subject should not continue as a subject.

Should you withdraw or otherwise discontinue participation, you will be compensated for the portion of the project completed in accordance with the Compensation section of this document.

VIII. Questions or Concerns

Should you have any questions about this study, you may contact one of the research investigators whose contact information is included at the beginning of this document.

Should you have any questions or concerns about the study's conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the Virginia Tech Institutional Review Board at irb@vt.edu or (540) 231-3732.

IX. Subject's Consent

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____
        Date_____
Subject signature

_____
Subject printed name

(Note: each subject must be provided a copy of this form. In addition, the IRB office may stamp its approval on the consent document(s) you submit and return the stamped version to you for use in consenting subjects; therefore, ensure each consent document you submit is ready to be read and signed by subjects.)

Appendix G: Interview Protocol

"Hello, my name is Chantel Simpson, and I am a Ph.D. candidate at Virginia Tech. I would like to start by thanking you for your participation in this research study. Today, I am meeting with you all to ask a few questions about your experiences in STEM as an African American male in a STEM or STEM related degree program. I will be using the content of this discussion in my dissertation and academic publications. This interview will be audio recorded to allow me to better reflect on this conversation, however no identifiable information will be used in the study. There is no physical risk associated with participation in this interview, however some of the topics discussed may be somewhat uncomfortable. Please note that you may discontinue participation at any time without penalty. Before we begin, I will go over the process of informed consent and ask you to sign a form indicating your consent to participate in this interview."

Starting Questions:
- Describe your ideal goals upon completion of the degree program.
  Probe: How likely do you think you will obtain that goal?

Are African American males feeling a sense of belonging within STEM degree programs?
- Describe how you first became aware of your race/ethnicity? How has this awareness impacted your experiences in STEM? *Probe: Would you share a significant experience or experiences that made you aware of it?*
- Would you please describe some experiences that your feel shaped your sense of belonging in STEM? How have those impacted you? *Probe: With all of these experiences, did you have a mentor? How do you define that role?*
- Would you please describe describe any difficult and/or challenging experiences that you have had working with faculty members? Would you please describe any difficult and/or challenging experiences that you have had working with peers?
- Take a moment to think about what you need to work successfully and identify three to five expectations that you have of faculty members that will allow you to work successfully? Do you feel that your faculty members are aware of these expectations? *Probe: Why or Why not? Can you give an example?*
- Describe your level of participation in extracurricular or co-curricular STEM activities (such as MANRRS, NSBE, Internships etc). *Probe: How frequently do you participate in these activities? Are you aware of the activities of the organization on campus? How did you find out about these activities?*
- Have you filled to role of mentor for anyone in your degree program? *Probe: Thinking about this relationship, please describe how the relationship began and how you interacted with one another.*

How are coping behaviors being evidenced among African American men within STEM degree programs?
- Take a moment to think about how you would describe yourself as a professional in the STEM field. *Probe: Could you share a significant experience where you found yourself changing the way you present yourself in order to participate?*

- How do you express your identity in STEM? *Probe: Do you feel that this expression impacts the way others see you? If so, how?*
- Describe a successful student in the STEM field? Do you feel that you fit those characteristics? If not, what are those characteristics? *Probe: Describe what a STEM professional looks like when you envision them*
- Describe what it is like to work collaboratively on a STEM assignment. Describe your role and responsibilities on that team. *Probe:*

Ending Questions:
- I would like to take the time to open the floor to anything that has come up that you feel you have not been able to share yet, but that you also feel may be important. *Probe: Do you have any questions for me?*