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The Contribution of African American Parents' STEM Racial Socialization and Support to Adolescent Academic Outcomes

Rachel J. Davis
Virginia Commonwealth University

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Adolescent Academic Outcomes

A thesis submitted in partial fulfillment of the requirements for the degree of Master of

Science at Virginia Commonwealth University.

by

Rachel J. Davis

Bachelor of Science

Old Dominion University, 2019

Director: Fantasy T. Lozada, PhD

Assistant Professor, Department of Psychology

Virginia Commonwealth University

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Abstract

THE CONTRIBUTION OF AFRICAN AMERICAN PARENTS' STEM RACIAL

SOCIALIZATION AND SUPPORT TO ADOLESCENT ACADEMIC OUTCOMES.

Rachel J. Davis

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science

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Major Director: Fantasy T. Lozada, Assistant Professor, Psychology

Historically, African Americans have experienced various inequalities in education that have long contributed to overall educational attainment gaps within the African American community (St. Mary, Calhoun, Tejada, & Jenson, 2018). Thus, African American parents are tasked with instilling messages of racial pride into their children and providing educational support that serve as protective factors against racial discrimination in education (Koch, Lundh, & Harris, 2019). Theoretical frameworks provide a basis of understanding how parent socialization contributes to African American educational outcomes, specifically noting the role of parents' beliefs and values in dictating mechanisms of value transfer (e.g., buying toys or learning materials; Eccles, 2007), with emphasis on cultural context within African American families (Taylor, Clayton, & Rowley, 2004). However, less is known about the specific race-based messages parents provide their youth in a STEM context. Specifically, I examined race-based academic socialization messaging and support with regard to STEM (i.e., STEM racial academic socialization) in a sample of 128 parent-adolescent dyads. The relationships between STEM racial socialization/extracurricular support and grades were not mediated through academic self-concept, however, STEM extracurricular support was a significant predictor of

STEM grades. Interestingly, when academic-self-concept was entered into the model, pride messages were significantly related to STEM grades, suggesting that African American STEM racial socialization and support are complex processes that warrant further investigation.

Vita

Rachel J. Davis was born on March 2, 1997, in Washington, DC to parents Ralph and Valerie

Davis. She graduated from McKinley Technology High School, Washington, DC in 2015. She

then went on to study at Old Dominion University, Norfolk, VA, where she received her

Bachelor of Science degree in Psychology.

Introduction

Historically, African Americans have experienced various inequalities in education ranging from segregated and under-resourced schools, differential treatment by teachers and administration (D'hondt, Eccles, Houtte, Stevens, 2016), and tracking into lower or remedial course curriculum (Ackerman, Kanfer, & Calderwood 2013). Such racial disparities in education have long contributed to overall educational attainment gaps within the African American community (St. Mary, Calhoun, Tejada, & Jenson, 2018) and low minority representation in specific professional fields of study (Archer, Dewitt, Osborne, 2015). In the face of these barriers, African Americans continue to seek educational equality. For instance, African American parents instill messages of racial pride into their children and provide educational support that serve as protective factors against racial discrimination in education (Koch, Lundh, & Harris, 2019). African American parents' racial messaging (i.e., racial socialization) and educational support (i.e., parental involvement) have often been considered in relation to African American students' educational experiences and outcomes more broadly, yet, there is also a specific need to understand African American parents' promotive parenting with regard to education in science, technology, engineering, and mathematics (STEM) given the emphasis on STEM education in the United States (National Science & Technology Council, 2018).

According to data collected by the National Science Foundation (1996-2016), African American representation in STEM is continuously low. Over the course of two decades, the percentage of degrees earned by African Americans in various STEM fields have ranged from 4.15 to 11.96. While participation has increased in some STEM subfields (e.g., psychology, social and biological sciences), there has been a decline in participation in other subfields (e.g., engineering, mathematics and statistics, physical sciences, and computer sciences). Indeed, there

is a prevalent need for research that is aimed at bridging STEM involvement gaps. One way to increase participation in STEM may be to target experiences that African American students have with STEM-related content at home. The goal of the current study is to understand how African American parents' STEM academic socialization supports student academic self-concept and subsequent academic performance. Specifically, the current study will examine academic messages from parent to child situated within discussions about the connection between race and STEM. The current study will examine how African American parents' STEM – racial socialization (RS) and STEM – extracurricular support (ES) impacts their students' academic performance through students' academic self-concept.

Literature Review

Theoretical Frameworks

In the current study, I examine the associations between parental educational involvement and youth's educational outcomes from the perspective of Eccles' (2007) Model of Parental Influence (MPI). Eccles posits that family demographics, such as race, shape parents' general and child-specific beliefs and subsequently their parenting practices and child's cognitions and behaviors. Specifically, Eccles describes that the messages that a parent communicates to their child are influenced by their beliefs. Other suggested mechanisms of transferring a parent's beliefs and values to the child may include providing experiences or opportunities (e.g., buying toys or learning materials). In a comprehensive review of the literature, Šimunović and Babarović (2020), grounding their research in Eccles' model of parental influence and Eccles' Expectancy-Value Theory (1983), examined the socializing influence of parental beliefs in the STEM educational domain. This review found that parent's beliefs and socialization practices had several implications for child STEM outcomes, for example, parents with positive STEM

attitudes were more likely to sponsor activities such as museum visits, which in turn affected the child's motivation (Szechter & Carey, 2009; Fan & Williams, 2010; cited in Šimunović and Babarović, 2020). Previous studies have applied this model to investigate socialization practices, but the literature remains unclear of the mechanisms by which this process occurs. I apply this model to understanding academic-based parenting behaviors (i.e., racial socialization messages about STEM and extracurricular support in STEM) and academic-based child outcomes (i.e., STEM academic self-concept and STEM academic performance) in the context of African American families.

Additionally, the current study draws from Taylor, Clayton, & Rowley's (2004) conceptual model of academic socialization. This model highlights the importance of socioeconomic and cultural context and suggests that these factors influence parents' own school experiences, parent cognitions about school, parent involvement practices, child's school adjustment and academic outcomes, and the child's personality. More specifically, this theory posits the importance of cultural context in the relationship between parent beliefs and practices and child outcomes surrounding African American families and the contexts surrounding their unique experiences in education. Consistent with this framework, it is important to use research design that embeds cultural context and captures within group variation in cultural-related experiences. African Americans have historically experienced marginalization in the pursuit of education and thus, as a cultural group have adopted various parenting strategies that promote their children's academic success in an environment that is hostile to their achievement and prepare their children for potential race-based barriers to their success. In a recent study, Metzger and colleagues (2021) used this academic socialization conceptual framework to investigate profiles of Black parents' racial and academic socialization and their adolescents' academic outcomes. A latent profile

analysis revealed 6 profiles (i.e., academic socializers, low race salient socializers, preparation for bias socializers, unengaged socializers, multifaceted socializers, and race salient socializers) that highlight the variation in Black parents' racial and academic messaging and the implications of such messaging on adolescents' academic outcomes. One potential limitation of Metzger and colleagues' (2021) profile approach is the use of separate racial and academic socialization measurement. Yet, Taylor and colleagues (2004) discuss the integration of parents' experiences and beliefs about race with their own educational experiences to inform the ways they socialize their children around academics. Thus, racial and academic messaging may be integrated as opposed to separated and isolated messaging. Thus, the current study will examine an integrated form of racial and academic socialization messaging in African American parents' STEM racial socialization. Below, I review the literature on parental educational involvement, broadly and specific types of parental involvement among African American parents before further describing STEM racial socialization.

Parental Educational Involvement

Children's academic success is dependent on internal and external factors. Learning begins in the home, where parents are their child's first educators. As children enter schooling outside of the home, the parent-child dynamic shifts as the parent is no longer solely responsible for the child's primary education. Yet, parents continue to have a direct impact on the academic outcomes of their students through various types of involvement (Day & Dotterer, 2018; Dotterer & Wehrspann, 2016; Hill & Tyson, 2009; Ogg & Anthony, 2020). Parental educational involvement can be categorized into three dimensions: home-based involvement, school-based involvement, and academic socialization (Day & Dotterer, 2018). As outlined by Day and Dotterer (2018), home-based involvement typically encompasses the way parents structure the

home environment to support academics; school-based involvement includes parent communication with the school, volunteering, and attending parent-teacher meetings; and academic socialization can be described as the messages a parent communicates to their child about the value of education.

Parental educational involvement has been linked to many positive outcomes in children. For example, in an urban high school, (80% racial/ethnic minority), Dotterer & Wehrspann (2016) found that parental involvement in education was related to students' behavioral and cognitive engagement, and academic competence and achievement. It should be noted that while parental educational involvement is associated with positive youth outcomes, such outcomes are dependent on several variables. For example, Day and Dotterer (2018) found that greater academic socialization, in a sample of African American high school students and their families, alongside greater school-based involvement was beneficial for grade point averages of all students, whereas other combinations of parent educational involvement resulted in mixed findings. Specifically, low home-based involvement, when combined with moderate levels of academic socialization, was associated with lower GPA. In addition, a three-way interaction emerged as greater academic socialization and greater home-based involvement alongside less school-based involvement was associated with lower GPA. These findings suggest the importance of examining various aspects of parental educational involvement in relation to students' academic outcomes.

African American Parental Educational Involvement

Across the three dimensions of parental educational involvement described by Day and Dotterer (i.e., home-based, school-based, and academic socialization; 2018), African American parents tend to be most engaged with their child's education through home-based parental

involvement and academic socialization. This emphasis on home-based involvement and academic socialization reflects barriers to African American parents' school-based involvement. Clifford and Goncu (2019) discussed that African American parents experience barriers that make involvement within the school environment difficult. Examples of barriers include timing conflicts (i.e., parents having to work during school hours), tensions with the school (e.g., feelings of underappreciation), lack of information, and family care (e.g., having young children in the home). In another study with parents of high school students, Williams and Sanchez (2013) identified time poverty, lack of access, lack of financial resources, and lack of awareness as barriers that prevent parents from being involved in their child's education.

Despite these barriers, African American parents have still managed to create supportive strategies to support their children's education. Clifford and Goncu (2019) interviewed 14 African American parents of early childhood age children to better understand their parent educational involvement. These parents described their involvement in terms of home, community, and school environments. Specifically, home involvement encompassed activities (planned or spontaneous) within the home that aided in the child's learning and community-based involvement consisted of activities such as participation in local community centers, visiting local landmarks, and attending neighborhood association meetings (Clifford & Goncu, 2019). When parents' involvement did include communication methods with the school it tended to be in the form of responding to requests made by the school or coordinating times with family or friends, that enabled them to participate in their child's education (Clifford & Goncu, 2019). In another study of 130 African American students in K-12 education, Latunde and Clark-Louque (2016) also found that African American parents engaged in all three types of parental involvement, noting that 30% of parents in the study initiated contact with schools weekly and

40% initiated contact with schools monthly. Further, 60% of parents engaged in educational activities in the community. This variation in parental educational involvement methods is consistent with recent research on parental involvement typologies such that African American parents were represented in three typologies: Guiding, Lenient, and Advocate (Zhou & Bowers, 2020).

These aspects of home-based parental involvement are influential in predicting African American student success. For instance, Hardaway, Sterrett-Hong, De Genna, and Cornelius (2020) interviewed low-income African American mothers and their adolescents (at ages 14 and 16) in an effort to understand how parents respond to academic underachievement and how parents provide cognitive stimulation (i.e., a form of home-based involvement that includes having educational materials and engaging in enrichment activities) in the home. Researchers found nonpunitive responses to poor grades and cognitive stimulation at home were linked with higher academic achievement.

Academic socialization, messages about the importance of education, are also imperative to the development and promotion of positive school-related outcomes, specifically in African American families (Ispa et al., 2020; Suizzo, Robinson, & Pahlke, 2008; Taylor et al., 2004). In a study examining school and education conversations between 43 African American mother-child dyads, Ispa, Su-Russell, and Im (2020) identified these as the most prevalent topics of discussion: (a) high academic expectations, (b) encouraging students to prioritize school work, (c) the utility of education, (d) science topics, and (e) reading. Additionally, in a sample of 283 African American and Mexican American parents, Suizzo, Pahlke, Chapman-Hillard, and Harvey (2016) examined three types of academic socialization: active involvement (e.g., offering to help with homework, choosing activities for child to do that are stimulating or instructive),

demandingness of hard work, and autonomy support (encouraging the child to develop unique strengths). All such forms of academic socialization were associated with positive academic adjustment. Additionally, Day and Dotterer (2018) examined the impact of academic socialization on academic outcomes in a longitudinal study among African American 10th grade students and their parents. To assess academic socialization, parents and students were asked to complete surveys regarding the messages they gave or received in regard to education (e.g., advice on applying to college); greater academic socialization was associated with higher GPA and education attainment in African American adolescents. In sum, both parental messages and parental behaviors have been identified as important predictors of student success, yet to understand student outcomes related to STEM, it may be relevant to specifically examine parental messages and behaviors related to STEM.

Parental Involvement and STEM Outcomes among African Americans

There is limited research that examines the contribution of parental involvement specific to STEM among African American families yet, there are some exceptions. For instance, Baker (2015) examined family, neighborhood, and demographics as predictors of math achievement at kindergarten entry among a sample of 1,202 African American boys and their biological mothers. Relevant findings illustrated that mothers who helped their African American sons make sense of numbers in a meaningful way (e.g., playing counting games) promoted math skills at kindergarten entry. The effects of early math socialization extend beyond kindergarten and have implications for college outcomes. In a qualitative study, McGee & Spencer (2015) interviewed 24 high achieving Black college students majoring in STEM to better understand the long-term impact of parental involvement on the success of African Americans in STEM. Three themes emerged from the findings: a) parents' perseverance and sacrifice (i.e., advocating for

their children's educational goals); b) parents instilling self-efficacy; and c) parents as mathematics-educated teachers and role models in their lives. Finally, in the previously mentioned study on parental typologies (Zhou & Bowers, 2020), African American parents of high school students were most likely to be represented in the typology in which parental involvement was high in strong interactions and rules at home but with low interactions at school (i.e., the "guiding" typology). In comparison to the typology that had the strongest ties and interaction with the school (i.e., the "advocate" typology), and the typology that had lower interactions with the school and at home (i.e., the "lenient" typology), there were no significant differences in the rates of the children engaging in and majoring in STEM in college and entering STEM professions by age 26 (Zhou & Bowers, 2020).

This limited work appears to offer mixed findings on the associations between parental educational involvement and STEM outcomes among African Americans. The Baker (2015) and McGee and Spencer (2015) studies both examined parents' *STEM-relevant* involvement and found that greater STEM-relevant involvement was associated with more positive STEM outcomes. In contrast, Zhou and Bowers (2020) examine *general* parent educational involvement and found that the typology of general educational involvement in which African American parents were most likely to be represented was associated with non-significant differences in STEM-relevant outcomes in comparison to other typologies. This suggests that when trying to understand how African American parents' foster their children's STEM success it is important to examine parents' STEM-relevant parenting practices in relation to children's STEM-related outcomes. In the current study, I consider the previous literature on parental educational involvement common among African American parents and conceptualize parent involvement as it relates specifically to STEM with an emphasis on implicit and explicit communication about

STEM and STEM education (i.e., academic socialization; Day & Dotterer, 2018) that span across the home and community environments.

Limitations of the Conceptualization of Parent Academic Involvement

for African American families

Parental academic involvement has been broadly defined as home-based, school-based, and community-based involvement (Day & Dotterer, 2018). Though these dimensions account for much of parent involvement, they fail to capture the full and unique parenting experience of African American families. Specifically, in addition to providing their children with adequate educational support, African American parents are responsible for helping their children navigate through racialized academic experiences and do so through strategies such as acting as role models, providing ways to understand racialized events, and coping strategies (Byrd & Ahn, 2020) as well as communicating messages about the meaning of one's racial group membership and interactions with members of the same or different racial groups (Brown & Krishnakumar, 2007).

As such, parent educational involvement for African American parents likely includes talking to their children about race and education and sharing their knowledge of racialized academic experiences as a means of preparing their children to achieve academic excellence in the face of racial adversity. Research on the concept of racial socialization, the intergenerational transmission of messages about the meaning and experience of one's racial group membership and inter-racial interactions has described the ways in which African American parents intentionally provide their children with messages about race to combat negative stereotypes about African American achievement in educational systems (Bowman & Howard, 1985; Stevenson & Arrington, 2011) and how racial socialization is a direct contributor to African

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American youth's academic outcomes (Hughes, Witherspoon, Rivas-Drake, & West-Bay, 2009; Hurd, Zimmerman, & Xue, 2009) and as a moderator of the effects between racial discrimination on school and academic outcomes (Wang & Huguley, 2012). African American parents seem to intuitively know that the intersection of race and education will have an impact on their children's academic trajectories. Williams et al. (2018) interviewed 76 African American mothers of children preparing to enter the first grade about the role that they perceived race would play in their child's education. Forty-two percent of the mothers interviewed indicated that they believed that race would play some role or a big role in their child's education. However, the authors note that for many of the mothers that indicated that race would play a small role or no role in their child's education did so because they believed that there were protective factors in place in the child's home, school, and community environments that would minimize the effects of race. One such factor cited was mother's own intentions to protect their child through racial socialization or by intervening/advocating for their child at school when necessary (Williams et al., 2018).

Despite the recognition that African American parents' experiences with and beliefs about race may shape the ways in which they are involved with their children's education, current parental involvement research and measurement does not adequately incorporate or consider parents' messaging about race. In the current study, I will investigate parents' racial socialization messages about STEM as a form of academic socialization in African American families.

Racial Socialization as a Form of Academic Socialization

Racial socialization messaging includes cultural socialization, preparation for bias, and promotion of mistrust (Hughes et al., 2006). Cultural socialization messages teach children about

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the heritage, history, and legacy of one's ethnic-racial group. Preparation for bias messages bring awareness to children about racial discrimination and how to cope with racial discrimination. Promotion of mistrust messages emphasize the need to be cautious, wary, or mistrustful of interracial interactions. These messages are also sometimes an explicit avoidance of the discussion of race (Hughes et al., 2006). Additionally, other researchers have identified racial socialization that communicates negative messages about one's own racial group in which parents may denigrate African Americans' contributions to broader society or express wariness about interactions with other African Americans (White-Johnson, Ford, & Sellers, 2010). As African American parents consider the ways in which their children's schooling and academic experiences more broadly may be influenced by race, they may communicate messages that specifically discuss the role of race in education or African Americans' contributions to specific academic fields.

For instance, parents may combine messages of cultural socialization with messages about STEM by telling stories about famous African American scientists and mathematicians. Parents may also highlight potential educational barriers to African Americans achieving in STEM fields because of stereotypes about African American intellect and racism in STEM. Some parents may even communicate negative messages about African Americans in STEM by telling their child that African Americans have not contributed to the advancement of STEM fields and that African Americans do not have the capacity to achieve in STEM fields of study. These examples provide possible ways in which the dimensions of racial socialization map onto academic contexts, however, further research is needed to capture the race-specific messages African American parents give STEM and the association of these messages to their children's academic outcomes. I know of no research, to date, that has explicitly examined race-specific

messages from parents about a given content area such as those represented in STEM. In the current study, I will address this gap in the literature by including African American parents' STEM racial socialization messages in my conceptualization of African American parent educational involvement.

Mechanisms of Parental Educational Involvement on Students' Academic Achievement

Another limitation to the parent educational involvement literature is that there have been few examinations of the mechanism by which parental involvement is associated with youth's academic performance among African American samples. One likely mechanism may be through students' academic self-concept. In the broader literature and theoretical conceptions of student academic achievement and motivation, youth's self-beliefs about academics are noted as a significant influence on youth's academic achievement. Specifically, academic self-concept, an individual's self-perception about their academic abilities and competencies in an academic domain (Hoge & Renzulli, 1993), has been identified as a predictor of academic achievement (Cokley & Chapman, 2008; Choi, 2005; Gerardi, 2005; Prince & Nurius, 2014), thus researchers have sought to understand its relevant predictors.

According to Eccles' Model of Parent Involvement, parents' specific behaviors directly impact their child's self-perceptions as well as their academic outcomes (Senler, & Sungur, 2009). For example, Covarrubias, Jones, and Johnson (2018) examined a population of first generation and continuing generation college students to better understand how parent-student conversations were linked with student academic self-concept and grades. They found that parent-student conversations, which included discussions about how to prepare for college, how to apply to college, what to expect in college, and general discussions about college, were positively linked to academic self-concept and grades and that students with higher academic

self-concepts had higher grades. In the current study, I will examine students' academic self-concept in STEM as a mediator to the associations between African American parents' STEM-related parental involvement (STEM racial socialization and extracurricular support) and students' STEM academic achievement. Below, I further describe the development of academic self-concept.

Formation of Academic Self-Concept in Adolescence

Adolescence marks a time of significant developmental change, consisting of cognitive, physical, and emotional development. There are notable shifts in peer relationships, socio-emotional development, and social structures. During this period, adolescents are also charged with the task of making sense of the world around them and situating themselves within it. Erikson (1950) marked adolescence as the period where youth will begin to develop the self, resulting in either identity synthesis or identity confusion and includes self-conceptions related to culture, gender, religion, and academics (Erikson, 1968; Harter, 2006). Positive development of one's self-concept has important implications for positive academic and career outcomes (Barber, Eccles, & Stone, 2001); thus, it is relevant to include self-conceptions as an aspect of developmental process when discussing adolescents' academic (e.g., STEM) outcomes.

Academic self-concept is conceptualized as the self-evaluation of one's educational abilities and achievements (Marsh & O'Mara, 2008) and is positively influenced by one's own academic abilities, and negatively influenced by comparison with others within the immediate context (Marsh & Parker, 1984). In a (2007) study, Awad analyzed a sample of 313 school-aged African American students and found that academic self-concept significantly predicted students' GPA. Another study sought to predict the academic achievement of African American students attending a historically Black university (Cokley & Chapman, 2008). Relevant findings

of a path analysis revealed a positive direct effect of academic self-concept on grade point average. Thus, academic self-concept is an important and relevant construct in predicting educational outcomes.

The development of academic self-concept during early middle school is particularly relevant to early middle school academic performance. As children progress through grades 1-6, these students are met with higher expectations and begin to receive feedback on their schoolwork. Although each grade provides its own challenges, 6th grade is particularly trying as it marks a transition period. In the US, 6th grade (11-12 years old) is typically regarded as either the last year of elementary school or the first year of middle school. With that said, the expectations for 6th graders are fairly stable. Throughout this psychosocial stage of development, students are developing a sense of competence in their abilities (industry) or are left with feelings of failure (inferiority). These feelings are the product of encouragement, or lack thereof, from parents and teachers. For example, a student who experienced difficulty in a subject, but was properly encouraged by their teachers and parents will likely go on to develop feelings of competence towards learning even when faced with challenging tasks. On the other hand, another student who experienced the same subject difficulty but lacked encouragement from teachers and parents will likely go on to develop feelings of failure. Additionally, According to Wigfield and Eccles (2002), by the sixth grade, most students will have established academic subject preferences and middle school generally is also a period where students begin to make decisions about their future coursework based on their self-conceptions and preferences for specific subject areas such as science, technology, and math which has implications for future academic and career trajectories (Dawes, Horan, & Hackett, 2000; Eccles, 2009). The current study seeks to understand how parent socialization practices inform student outcomes. Provided

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the goal of the current study, 6th grade is a relevant population in that their self-concepts will have taken form to help understand how to better serve younger students in the future.

Potential Covariates in Understanding Parent Socialization and Student STEM Outcomes

This paper explores the intersection between parent racial and academic socialization, as well as their extracurricular support in STEM in predicting students' academic self-concept and achievement. Student gender has been previously identified as correlates of parents' academic socialization and students' academic outcomes. Researchers have found gender stereotypes to play a role in how parents perceive their students' abilities in math, where boys are rated as higher math performers than girls (Furnham, Reeves, & Budhani, 2002). Researchers have also found that male students are likely to report higher math and science self-concepts (Skaalvik & Skaalvik, 2004; Jansen, Schroeders, & Ludtke, 2014), even when controlling for student achievement (Jansen et al., 2014).

Current Study

In the current study I will apply previous theory and literature on African American parents' general academic parenting behaviors and youth's general academic outcomes to parents' STEM academic parenting behaviors and youth's STEM academic outcomes. Specifically, I will investigate the associations of African American parents' STEM racial academic socialization and STEM home-based parental involvement with students' STEM academic achievement through STEM self-concept. In the current study, limitations of the previous literature on parental involvement and academic socialization among African American families are addressed in two ways: (1) following conclusions from the work by Hardaway and colleagues (2020) with African American parents, home-based parental involvement was expanded beyond helping the child with homework to include cognitive stimulation (i.e., having

educational materials and engaging in enrichment activities) and (2) following conclusions from Williams et al. (2018) about African American parents' concerns about the role of race in their children's education, I will examine race-based academic socialization messaging with regard to STEM (i.e., STEM racial academic socialization). I hypothesize that (1) cultural pride STEM-racial socialization messages (e.g., messages about the contributions of African Americans in STEM) and racial barrier STEM-racial socialization messages will positively predict STEM academic achievement; (2) negative STEM-racial socialization messages (e.g., messages about mistrust of STEM or lack of African American contribution to STEM) will negatively predict STEM academic achievement; (3) greater STEM- extracurricular support will positively predict STEM academic achievement; (4) STEM academic self-concept will mediate associations between STEM-racial socialization and STEM academic achievement; and (5) academic self-concept will mediate associations between STEM-extracurricular support and STEM academic achievement.

Methods

The current study uses data collected over the course of two years as a part of a larger study conducted through the Parenting and African American STEM Success Study (PAASS). The PAASS study examines the relationships among African American parents' beliefs about race, their socialization of their middle school children, and children's outcomes in science and mathematics.

Participants

Data for this study were collected from a larger longitudinal study of African American parents' STEM promoting parenting practices and their middle school students' STEM academic success. For the current study, the target sample was the 344 6th-grade students across five

schools within two midwestern U.S. school districts who participated in the first wave of data collection. Students ranged in age from 10 to 12 years old (M=11.05, SD=0.42) and a little more than half of the students were female (n=66, 52.4%). All students were identified by school administration as African American, consistent with eligibility criteria for the larger study recruitment. However, students in the sample self-identified as African American/Black (n=96, 76.8%), multiracial (n=15, 12%), Hispanic (n=1, .8%), Native American (n=7, 5.6%), White (n=1, .8%), and other (n=5, 4%).

Of the 344 students who participated in wave one of the study, 147 students had one parent participate in the parent survey component of the study with an 80% completion rate for the target survey items for this study. Parent survey reports revealed that parents reported various caregiver relationships with students including: mothers (*n*=103, 81.1%), fathers (*n*=10, 7.9%), stepmothers (*n*=3, 2.4%), grandmothers (*n*=5, 3.9%), and foster-mother (*n*=1, .8%). Five parents did not specify (3.9%), and 1 parent did not provide a response. For simplicity, all caregivers in the context of the current study will be referred to as parents. Parents ranged in age from 26 to 69 (*M*=39.4, *SD*=8.4) and racially identified as African American/Black (*n*=98, 77.2%), multiracial (*n*=14, 77.2%), Native American (*n*=1, .8%), White (*n*=13, 10.2%), and other (*n*=1, 0.8%). About 10.3% of parents had less than a high school diploma, 19% had a high school diploma, 20.6% had an associate, training, or technical degree, 23% had some college, and 27% had a college degree or more. Approximately 35% of parents reported they were single, 3% were single and living with a partner, 48% were married, and 14% were divorced, separated, or widowed.

Procedure

As part of the larger, longitudinal study, data were collected annually between 2014 and 2016 from students in grades six to eight and their parents. The present study utilized data reported by students, their parents, and school administration during the first wave of data collection. Students were recruited from five schools within two midwestern U.S. school districts. School selection required permission from the principal of the school, the school board, and the superintendent of the district. Both school districts were located in the outer suburban areas of a larger midwestern city. According to statewide school data these districts are composed of a diverse racial and economic population with the percentage of Black/African American students ranging from 26% - 57% of the student population, and the percentage of economically disadvantaged students ranging from 49% - 75% of the student population. Child participants were asked to complete a survey that asked questions about their experiences in school, beliefs about their racial group, and the activities that they are involved in. Students took approximately one hour to complete the survey. Students received $20 for participating in the study, regardless of full survey completion. After student surveys were collected, parents who indicated interest in participating in the parent component of the study were asked to complete a survey about their beliefs about race, experiences with racial discrimination, their general and academic parenting practices, and their children's academic and socioemotional skills. Parents were given the option of completing the survey on their own online or to go to their local library on specified data collection days. All parent surveys were accessed via an online link and took about 1 hour to complete. A $50 MasterCard gift card was provided to parents as compensation following their completion of the survey regardless of survey completion. Additionally, participating schools agreed to provide math and science grade data for participating students from their record database at the end of the school year. For the current study, students' final

school year math and science grades were matched with student and parent dyad data. Of the 145 student-parent dyad data used for the current study, only 128 students had matching school record grade data for inclusion in study analyses.

Measures

      Parent STEM Racial Socialization. Parents reported their socialization practices as it pertains to STEM and race using a scale developed for this study. This scale was developed to reflect the dimensions of racial socialization measured by the Racial Socialization Questionnaire – Parent version (RSQ-P) which assesses parents' racial pride, racial barrier, mistrust, and negative messages about African Americans. For the STEM racial socialization scale (see Appendix A), 4 items were developed to assess racial pride messages with regard to African Americans' contribution to STEM fields (sample item: "Pointed out successful Black people in science and/or math field to the Target Child"), 4 items were developed to assess racial barrier messages with regard to African Americans' experiences of discrimination in STEM (sample item: "Told the Target Child that teachers may have low expectations for his/her life science performance because he/she is Black"), and 6 items were developed to assess negative messages about African Americans' abilities and contributions to STEM (sample item: "Told the Target Child that Blacks are not as good in science as Whites or Asians"). Additionally, 3 items were developed to assess promotion of mistrust messages (i.e., Hughes & Chen, 1997) with regard to science and technology (sample item: "Told the Target Child Blacks have not benefited from advancement in science and technology"). Items were rated on a scale 1 (not at all) to 3 (more than two times).

      Parent STEM Extracurricular Support. Parents reported the ways in which they provided encouragement and support for their students' participation in STEM activities using a

scale developed for this study. Items were rated on a scale 1 (not at all) to 3 (more than two times). For the STEM extracurricular support scale (see Appendix B), 12 items were developed to assess how frequently parents enroll their Target child into science/math activities (2 items; sample item: "Enrolled Target Child in science/math after school activities or clubs [e.g., Science Olympiad]"), purchased supplemental math/science materials (6 items; sample item: "Purchased math or science computer or video games for Target Child"), and encouraged science activities (4 items; sample item: "Helped Target Child develop a science project [e.g., science fair, for fun]).

Student STEM Academic Self-Concept. The academic self-concept scale was adapted from Nicholls (1979) measure on children's reports of self-concept. Students reported on their self-perceptions of their abilities in math and science (see Appendix C). Students were asked to rate themselves on a scale of 1 (far below average) to 7 (far above average) within the listed domains (sample items: "In [fill in domain] I am…"). A composite score of STEM academic self-concept was created by computing the mean of the math and science items.

Student Math-Science Grades. Schools reported either quarter, semester, or annual grades for each student. Grades were reported as A's, B's, C's, D's and F's and were re-coded to the following: A=5, B=4, C=3, D=2, F=1. In the present study I utilize math and science grades by creating averages across quarter, semester, or annual grades for both math and science. Final math and science averages were then averaged together to create one composite average for Math-Science grades.

Demographic Controls. Student gender is used as a demographic control in the present study. Students self-reported gender on the demographic portion of the student survey that asked: "Please insert your gender" and reported: 1 = Male or 2 = Female.

Analytic Approach

Prior to primary analysis, descriptive statistics, correlations, assumption analysis were conducted using IBM SPSS Statistics version 27. Additionally, exploratory factor analyses were conducted on the STEM racial socialization and STEM extracurricular support measures developed for this study to determine subscale scoring. Given previous research that suggests correlations between parents' racial socialization messages (e.g., White-Johnson, Ford, & Sellers, 2010) and between parents' academic socialization messages (e.g., Cross et al., 2019), promax rotations will be used to allow for correlations between the factors. To examine the suggested number of extracted factors, examination of eigenvalues greater than 1 and the Scree plot were used.

Finally, primary mediation analyses were conducted using the PROCESS Macro in SPSS, controlling for demographic variables associated with the key study variables (Model 4; Hayes, 2012). Mediation models examined the mediating effect of STEM academic self-concept in the association between STEM racial socialization/STEM extracurricular support and grades. Separate mediation models were conducted for each subscale of STEM racial socialization and STEM extracurricular support.

<div align="center">

Results

</div>

Preliminary Analyses

Exploratory Factor Analysis (EFA) of STEM Racial Socialization and Extracurricular Support. To determine the subscale scoring for the STEM racial socialization and STEM extracurricular support variables, I conducted an EFA on each set of items. For the EFA for STEM racial socialization, 16 items were included. One item cross loaded onto barrier and mistrust messages so it was not used. The results of the EFA suggested that three factors

explained over 78% of the variance. The Scree plot and eigenvalues also suggested that a three-factor structure was represented among the items. The factor loadings for the STEM racial socialization items are displayed in Table 3. Factor 1 represented STEM racial pride messages (5 items; α = .85 for the current sample). Factor 2 represented STEM racial barrier messages (4 items; α = .70 for the current sample). Factor 3 represented both STEM negative messages about African Americans and STEM promotion of mistrust messages (7 items; α = .90 for the current sample). Thus, subscale scores for STEM racial pride, STEM racial barriers, and STEM mistrust/negative were created from the mean of individual item responses that loaded within each factor.

For the EFA for STEM extracurricular support, 12 items were included. The results of the EFA suggested that one factor explained over 36% of the variance. The Scree plot and eigenvalues also suggested that a one-factor structure was represented among the items. The factor loadings for the STEM extracurricular support are displayed in Table 4. Thus, a scale score for STEM extracurricular support was created from the mean of individual items responses across the 12 items (α = .83 for the current sample).

Descriptive Statistics. Descriptive statistics were run on study variables to examine normality (see Table 1). All study variables demonstrated normality with the exception of STEM mistrust/negative messages, which demonstrated both positive skew and kurtosis with values outside of the traditional -2 and +2 values. Both Winsorizing and square root transformations were attempted to improve the skew and kurtosis of the STEM mistrust/negative variable. However, neither method improved the normality of the variable. Thus, no transformations were used on the final STEM mistrust/negative variable. Regarding STEM racial socialization variables, parents reported giving their students STEM racial pride messages on average "1 or 2

times" over the past year. On average, parents reported giving STEM racial barriers messages a little more than "not at all" over the past year. Finally, parents reported giving STEM racial mistrust/negative messages to their students, on average, approximately "not at all" over the past year. Regarding STEM extracurricular support, parents reported, on average, engaging in some type of support a little less than "1 or 2 times" over the past year. Regarding STEM academic self-concept, on average, students reported feeling that they were approximately "average" with regard to STEM (4 on a scale from 1-far below average to 7-far above average). Finally, from the school reported data Math-Science grades on average were at a "B" level among the current sample.

Bivariate Correlations. Bivariate correlations of the variables are presented in Table 2. Parents who reported giving more STEM racial pride messages also reported giving more STEM racial barrier messages, STEM mistrust/negative messages, and providing more STEM extracurricular support to their children. STEM racial pride messages were not significantly associated with students' STEM academic self-concept or math-science grades. Parents who reported giving more STEM racial barrier messages also reported giving more STEM mistrust/negative messages. However, parent STEM racial barrier messages were not significantly associated with students' STEM academic self-concept or math-science grades. Parents' STEM mistrust/negative messages were not significantly associated with students' academic self-concept or math-science grades. Parents' STEM extracurricular support was not related to students' STEM academic self-concept yet was positively associated with math-science grades. Finally, students' STEM academic self-concept was significantly associated with students' math-science grades such that greater STEM self-concept was associated with higher math-science grades.

Demographic Associations with Key Variables. To examine the association of the demographic variable of student gender with the key study variables, t-tests were conducted. Regarding parents' STEM racial socialization messages, there were no significant student gender differences regarding parents reports of STEM racial pride messages, (t[137] = -.002, p = .998), STEM racial barrier messages, (t[141] = -.184, p = .855), and STEM mistrust/negative messages, (t[141] = -.738, p = .464). There were also no significant student gender differences regarding parents' reports of STEM extracurricular support, (t[143] = .158, p = .875. Significant differences by student gender did emerge for STEM self-concept, t(335) = 2.849, p<.05, with males (M = 5.19, SD = 1.31) reporting higher self-concept than females (M = 4.78, SD = 1.31). There were no significant student gender differences in how youth performed in math and science, t(124) = -1.415, p = .159. Given that student gender was associated with the mediator variable of student STEM self-concept, we controlled for student gender variables in all mediation analyses. These results are consistent with previous research that indicates that females typically report lower STEM self-concepts than males but demonstrate no significant differences in performance and in some cases outperform their male counterparts (Drysdale & Milne, 2004).

Mediation Analyses

Racial Pride Mediation Model. A mediation analysis determined that, when controlling for student gender, STEM self-concept did not mediate the effect of STEM racial pride messages on math-science grades (see Figure 1). Using the Baron and Kenny (1986) method for testing mediation, STEM racial pride did not predict STEM grades, β = .25, p = .077. Additionally, STEM racial pride did not predict STEM self-concept, β = -.14, p = .456. When both STEM racial pride and STEM self-concept were entered into a third model, the relation between STEM

self-concept and STEM grades was significant, $\beta = .25$, $p < .001$, and the relation of Racial Pride to math-science grades was significant, $\beta = .29$, $p = .033$. Thus, STEM self-concept did not mediate the effect of racial pride on math-science grades; STEM racial pride and STEM self-concept were positively associated with math-science grades such that more parent STEM racial pride messages and great STEM self-concept predicted higher math-sciences grades.

Barrier Messages Mediation Model. A mediation analysis determined that, when controlling for student gender, STEM self-concept did not mediate the effect of STEM racial barriers messages on math-science grades (see Figure 2). Using the Baron and Kenny (1986) method for testing mediation, STEM racial barriers messages did not predict math-science grades, $\beta = .16$, $p = .381$. Next, STEM racial barriers messages did not predict STEM self-concept, $\beta = .20$, $p = .422$. When both STEM racial barriers messages and STEM self-concept were entered into a third model, STEM self-concept ($\beta = .25$, $p < .001$) significantly predicted math-science grades, but STEM racial barrier messages did not predict math-science grades, $\beta = .16$, p $= .381$. Thus, STEM self-concept did not mediate the effect of barrier messages on math-science grades. However, greater STEM self-concept was associated with higher math-science grades.

Mistrust/Negative Messages Mediation Model. A mediation analysis determined that, when controlling for student gender, STEM self-concept did not mediate the effect of STEM mistrust/negative messages on math-science grades (see Figure 3). Using the Baron and Kenny (1986) method for testing mediation, STEM mistrust/negative messages did not predict math-science grades, $\beta = .29$, p $= .317$. Next, STEM mistrust/negative messages did not predict STEM self-concept, $\beta = .53$, p $= .162$. When both STEM mistrust/negative messages and STEM self-concept were entered into a third model, the relation between STEM self-concept and math-

science grades was significant, β = .25, p < .001, and the relation between STEM mistrust/negative messages and math-science grades remained nonsignificant, β = .15, p = .577. Thus, STEM self-concept did not mediate the effect of STEM mistrust/negative messages on math-science grades. However, greater STEM self-concept was associated with higher math-science grades.

Extracurricular Support Mediation Model. A mediation analysis determined that, when controlling for student gender, STEM self-concept did not mediate the effect of STEM extracurricular support on math-science grades (see Figure 4). Using the Baron and Kenny (1986) method for testing mediation, STEM extracurricular support was positively associated with math-science grades, β = .42, p = .038. Next, STEM extracurricular support did not predict STEM self-concept, β = -.002, p = .992. When both STEM extracurricular support and STEM self-concept were entered into a third model, the relation between STEM self-concept and math-science grades was significant, β = .25, p < .001, and the relation between extracurricular support and math-science grades remained to significant, β = .43, p = .026. Thus, STEM self-concept did not mediate the effect of Extracurricular Support on STEM grades. However, greater parental STEM extracurricular support and greater STEM self-concept were associated with higher math-science grades.

Discussion

The purpose of the current study was to understand how parents' racialized messages about STEM and their behavioral support of their students' STEM participation was associated with African American students' STEM academic performance through their STEM academic self-concept. We examined these relations among a sample of sixth-grade African American students and their parents. I applied Eccles' model of parental influence (2007) to understanding

the influence of parent practices (i.e., socialization and support) on student academic outcomes given that Eccles' suggests that the transference of beliefs (verbal and action based) from parent to child influence child outcomes (e.g., grades and self-concept). In addition, I applied Taylor, Clayton, and Rowley's (2004) model of academic socialization to understanding the contextual factors that are unique to African American families given the emphasis the model places on cultural context in the relationship between parent beliefs and practices and child outcomes and African American families' unique experiences in education.

Consistent with these theories, I expected that more positive STEM racial socialization messages (i.e., STEM racial pride), more messages that would prepare students for potential experiences with racial bias in pursuing STEM interests (i.e., STEM racial barrier messages), and more STEM extracurricular support would be associated with higher STEM self-concept and higher math-science grades among African American students. This set of hypotheses were only partially supported. Specifically, bivariate correlations did not reveal any significant associations between STEM racial socialization messages or STEM extracurricular support and STEM self-concept. However, STEM extracurricular support did demonstrate a significant bivariate association with math-science grades, such that greater parental STEM extracurricular support was associated with higher math-science grades among African American students. Yet multivariate analyses (i.e., mediation analyses) revealed that accounting for student gender and student STEM self-concept, more STEM racial pride messages were also associated with higher science-math grades. That STEM racial socialization messages and STEM extracurricular support did not demonstrate more significant associations with STEM self-concept and math-

science grades overall is surprising given that previous literature suggests that racial socialization is a positive predictor of academic outcomes (Hughes, Witherspoon, Rivas-Drake, & West-Bay, 2009; Hurd, Zimmerman, & Xue, 2009), and that parents' specific involvement around STEM elicits positive STEM outcomes (Ispa et al., 2020; McGee & Spencer, 2015).

I also expected that negative STEM racial socialization messages (i.e., STEM mistrust/negative messages) would be associated with lower STEM self-concept and lower math-science grades among African American students. These hypotheses were not supported, despite the above mentioned literature that connects separate racial and academic parenting practices being associated with academic outcomes in previous research (e.g., Hughes et al., 2009; Ispa et al., 2020). However, it must be noted that the EFA, loaded negative items and mistrust items onto the same factor, inconsistent with the conceptualization of these socialization messages (Hughes et al., 2009). Conceptually, promotion of mistrust messages emphasize the need to be cautious, wary, or mistrustful of interracial interactions (Hughes et al., 2006), whereas negative messages are about one's own racial group in which parents may denigrate African Americans' contributions to broader society or express wariness about interactions with other African Americans (White-Johnson, Ford, & Sellers, 2010). Future research should further explore these messages within STEM context to better understand how these messages translate across contexts because though these messages are conceptually different, statistically, they hang together indicating a need for further investigation. It should also be noted that the incidence of STEM mistrust/negative messages was very low in the current sample at approximately "not at all" in the past year with a small standard deviation. This low endorsement of STEM

mistrust/negative messages and lack of variation in endorsement may have contributed to the lack of significant findings found in the current study. Future research should consider means of more intentional sampling among parents of African American youth with the hope of capturing more variation around this construct. Additionally, asking students to report their perceptions of their parents sending STEM mistrust/negative may yield higher endorsement and variation for this construct; previous studies on racial socialization that compare parent and child report note differences and lack of concordance in reports (e.g., Hughes et al., 2009).

Consistent with previous literature, parental behaviors that reinforce education, specifically STEM education, are indicators of students' academic performance (Baker 2015; Hardaway et al., 2020). The current study adds to the literature by expanding upon the known ways in which African American parents are involved in their youths' education. As previously stated, parental academic involvement has been broadly defined as home-based, school-based, and community-based involvement (Day & Dotterer, 2018), which accounts for much of parent involvement, however, past literature is limited on how these constructs present themselves in the everyday lives of African American families. Future research should consider the specific involvement practices of this study and investigate the varying impacts. Provided the lack of research on STEM racial socialization and the complexity of African American parent socialization techniques, it is within reason that future research continues to explore how racial socialization can positively impact educational outcomes within a STEM context.

Finally, I expected that STEM self-concept would mediate associations between STEM racial socialization messages and extracurricular support and math-science grades. Findings

suggest that STEM academic self-concept does not mediate the relationship between STEM

racial socialization messages or STEM extracurricular support and math-science grades. Yet, for

both the STEM racial pride model and the STEM extracurricular support model, it appeared that

accounting for STEM academic self-concept appeared to reveal a stronger and sometimes more

significant association between these two constructs and math-science grades, suggesting that

STEM self-concept demonstrates a suppression effect on these associations. Researchers suggest

that one way to deal with the issue of such suppression effects by using the suppressor variable

as a moderator in analyses (e.g., Lancaster, 1999). Although this is inconsistent with the

theoretical frameworks on which the current study is based, future research may consider the

moderating role of African American students' self-concept instead to understand how academic

self-concept may change the association of STEM racial socialization messages and STEM

extracurricular support and math-science grades at varying levels of self-concept. Future research

should also assess a wider array of potential contributors to students' STEM self-concept to

better understand how it develops if it is not shaped from parents' racialized academic

messaging.

Despite the lack of expected associations and mediation in the current study, preliminary

analyses indicated that racial socialization subscales and extracurricular support were all

positively correlated with one another. It is conceptually feasible that parents who tend to

provide greater STEM racial socialization messages will also align their behaviors and practices

with said beliefs, thus greater extracurricular support. It was surprising to find that parents who

endorsed greater negative messages regarding STEM were also more likely to provide

extracurricular support to their children. This finding highlights the complex nature of African American parents' role in socializing their children, in that although African American parents may be wary of STEM, it is possible that they also recognize its utility.

Strengths and Limitations

The present study is not without limitations. The academic self-concept variable was limited in that it did not assess the different nuances associated between math and science and the self-concept. Eccles' (2007) situates academic self-concept as an outcome of parental influence; thus, it is possible that academic self-concept does not act as a mediator. While this is a possible explanation, it is conceivable that academic self-concept, within the context of the intersection between racial and academic socialization, does in fact play a significant role in the relationship between socialization and grades based on significant findings for the present study's mediation models that considered academic self-concept. Expanding the academic self-concept variable to account for the development of the self-concept within an academic space may expand our understanding of how to provide support for African Americans in STEM. With regard to covariates associated with STEM socialization and outcomes, the present study considered child gender and parent SES. Though child gender was associated with the key variables, no associations were found for SES, likely the result of limited variability within the sample. Approximately 70% of parent participants had obtained an associate degree or higher. As suggested in a previous study, parents with greater education may be less likely to endorse gender stereotypes in STEM or it may also be the case that such stereotypes are decreasing as time progresses (Muenks et al., 2019). Additionally, the sample consisted of more than 80%

female caregivers, suggesting that more variability within the sample could yield differing results.

Despite limited variability within the parent sample, the study utilized three types of reports (i.e., parent, student, and school reports) to mitigate any biases associated between variables because of shared method variance. A potential bias in responses may have been that parents responded in ways that were socially desirable. For example, when responding to survey questions regarding negative messages about African Americans in STEM to their youth, parents may have been hesitant to openly endorse such messages. However, future studies should explore the social acceptability of these messages in the Black community because of the disparities faced that have resulted in warranted weariness. Given that African Americans are not a monolithic group, I utilized a within group design to capture the variance within African American parents' socialization practices.

The present study extends the literature on racial and academic socialization by combining racial socialization and academic socialization measures to explore the unique messages African American parents express to their children surrounding STEM. Metzger and colleagues (2021) considered the intersection of academic and racial socialization; however, the constructs were measured separately. Other studies in the field explore these constructs as separate and have not investigated the nuances in the types of messages parents provide to their youth. Despite the aforementioned limitations, the current study established the need for future research to explore mechanisms incited by African American parents to integrate messages of race and STEM to instill values and beliefs in their youth that in turn predict student outcomes.

Future Directions

Future research should consider other mechanisms by which academic self-concept contributes to STEM racialized academic socialization. Thus, researchers should consider academic self-concept as a growth and development of one's self-concept in spaces where race may be salient (e.g., STEM settings with low minority representation). In addition to race, African American females must also navigate STEM as a gender minority and must confront the various stereotypes associated with being a member of each group, and the intersection of said stereotypes. In addition to considering gender as a covariate, it should also be investigated as a moderator between racial-academic socialization and STEM outcomes. Additionally, future research should actively recruit a more diverse parent sample to capture the variability in responses that might be present across various socioeconomic statuses and parent gender. Fathers accounted for less than 10% of the parent responses in this study, thus researchers should further investigate the unique role African American fathers play in the socialization of their youth in STEM contexts.

Conclusion

The relationship between STEM racial socialization and extracurricular support was not mediated through academic self-concept. Overall, findings showed that STEM extracurricular support was a significant predictor of STEM grades, however, pride, barrier/negative, and mistrust messages were not. Interestingly, when academic-self-concept was entered into the model, pride messages were significantly related to STEM grades, suggesting that African American STEM racial socialization and support are complex processes that warrant further

investigation. Due to the unique and historical experiences of African Americans in education, African American parents and caregivers play a unique role in socializing their youth for education settings. Indeed, findings warrant further investigation into mechanisms associated with parent practices to understand how African American are and can continue to support their youth.

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Table 1. Descriptive Statistics Table

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Racial Pride	142	1.00	3.00	2.1070	.60196	-.155	.203	-.992	.404
Barrier Messages	146	1.00	3.00	1.2038	.47525	2.682	.201	6.715	.399
Mistrust Messages	146	1.00	3.00	1.0675	.31620	5.320	.201	28.655	.399
Extracurricular Support	148	1.00	2.83	1.8274	.41049	.495	.199	-.319	.396
Math Science Acadmeic Self-Concept	338	1.00	7.00	4.9778	1.34218	-.586	.133	.007	.265
Math-Science Grade	128	1.38	5.00	3.6422	.92964	-.430	.214	-.768	.425
Valid N (listwise)	116								

Table 2. Correlations of Key Study Variables.

	1.	2.	3.	4.	5.	6.
1. STEM Racial Pride	-	.39***	.23**	.57***	-.07	.16
2. STEM Racial Barriers		-	.60***	.38***	.05	.08
3. STEM Mistrust/Negative			-	.23**	.07	.09
4. STEM Extracurricular Support				-	.04	.18*
5. STEM Academic Self-Concept					-	.33***
6. Math-Science Grades						-

*p < .05; **p < .01; ***p < .001*.

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Table 3. Rotated Component Matrix for STEM Racial Socialization
Rotated Component Matrix[a]

	Component		
	1	2	3
How often have you: - Discussed famous Black scientists with Target Child.	.073	.115	.786
How often have you: - Visited museums that have exhibits on Black accomplishments in science and math with Target Child.	.134	.148	.654
How often have you: - Talked to Target Child about the importance of Blacks contributing to scientific knowledge.	.039	.174	.859
How often have you: - Tried to counter negative stereotypes about Blacks' math abilities in conversations with the Target Child.	.040	.094	.747
How often have you: - Pointed out successful Black people in science and/ or math field to the Target Child.	.031	.102	.854
How often have you: - Told the Target Child that he/she may not be called on in math class because he/she is Black.	.302	.787	.126
How often have you: - Told the Target Child that Blacks are less likely to be recommended for advanced math and science courses than Whites of similar ability.	.345	.825	.162

How often have you: - Told the Target Child that teachers may have low expectations for his/her science performance because he/she is Black	.193	.829	.245
How often have you: - Told the Target Child that there are few Black scientists because people think they are not as capable.	.302	.848	.162
How often have you: - Told the Target Child that Blacks are not as good in science as Whites or Asians.	.958	.255	.060
How often have you: - Discouraged the Target Child from taking advanced math courses because Black people tend to not do well in them.	.864	.161	.112
How often have you: - Told the Target Child that Blacks have not contributed much to science.	.917	.278	.065
How often have you: - Told the Target Child that it is more appropriate for Whites or Asians to pursue careers in science or technology.	.958	.255	.060
How often have you: - Told the Target Child that math skills do not come naturally for Blacks.	.932	.231	.045
How often have you: - Told the Target Child that science has been used to harm the Black community (e.g., Tuskegee Syphilis Study).	.491	.400	.241

How often have you: - Told the Target Child Blacks should not trust technology.	.910	.202	.081
How often have you: - Told the Target Child Blacks have not benefited from advancement in science and technology.	.958	.255	.060

Table 4. Rotated Component Matrix for STEM Extracurricular Support

Rotated Component Matrix[a]

	Component		
	1	2	3
To what extent have you: - Enrolled Target Child in science/math summer camps.	.737	.056	.140
To what extent have you: - Enrolled Target Child in science/math after school activities or clubs (e.g., Science Olympiad).	.719	.014	.242
To what extent have you: - Purchased math workbooks for Target Child.	.694	.423	-.114
To what extent have you: - Purchased science workbooks for Target Child.	.670	.470	-.137
To what extent have you: - Purchased math or science computer or video games for Target Child.	.594	.401	-.040
To what extent have you: - Purchased board games involving math skills (e.g., Yahtzee, Monopoly) for Target Child.	.390	.466	.116
To what extent have you: - Purchased science/lab kits (e.g., chemistry sets, telescope, microscope) for Target Child.	.115	.723	.032
To what extent have you: - Purchased building kits (e.g., Knex, Rokenbok, Geomags, erector sets) for Target Child.	.022	.732	.121

To what extent have you: - Encouraged technology use (e.g., computers, iPad) for Target Child's learning.	-.132	.202	.768
To what extent have you: - Encouraged technology after-school activities or clubs (e.g., robotics, computer club) to Target Child.	.359	.109	.750
To what extent have you: - Made books about science available for Target Child-- either purchased or from the library.	.321	.578	.242
To what extent have you: - Helped Target Child develop a science project (e.g., science fair, for fun).	.210	.579	.149

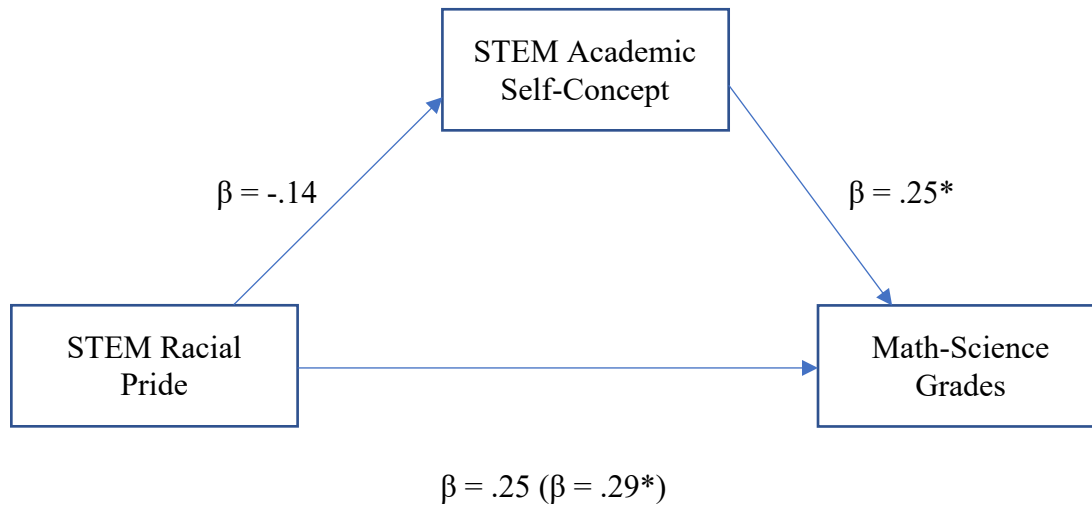Figure 1. Racial Pride Mediation Model

Figure 1. Standardized Regression Coefficients for the relationship between STEM racial pride and math-science grades as mediated by STEM academic self-concept. Standardized Regression Coefficients between STEM racial pride and math-science grade, controlling for STEM academic self-concept, is in parentheses.
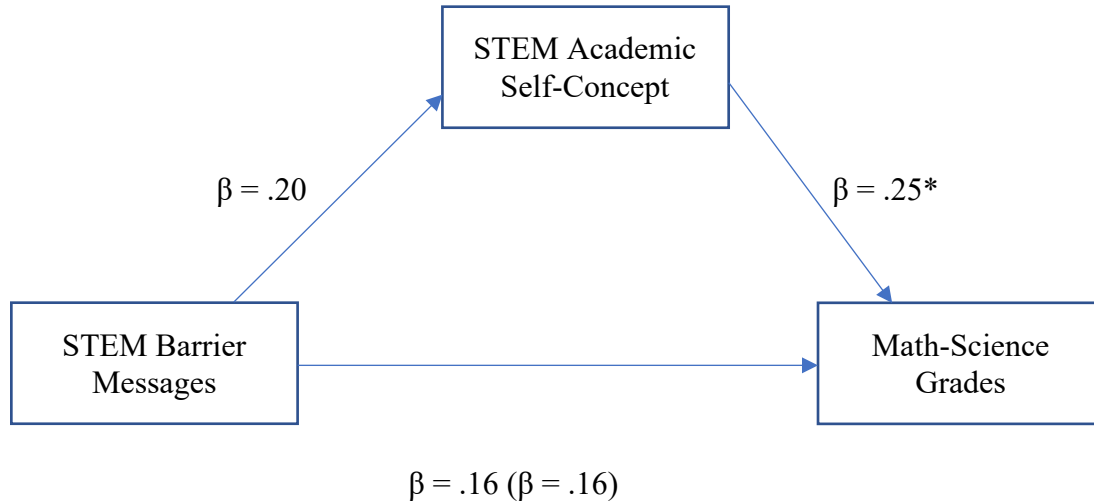
*p < .05

Figure 2. Barrier Messages Mediation Model

Figure 2. Standardized Regression Coefficients for the relationship between STEM barrier messages and math-science grades as mediated by STEM academic self-concept. Standardized Regression Coefficients between STEM barrier messages and math-science grade, controlling for STEM academic self-concept, is in parentheses.

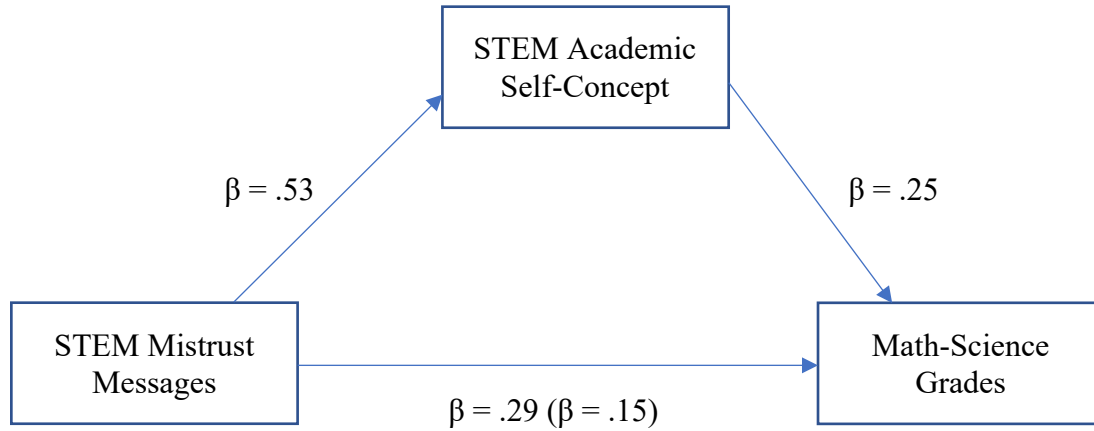$*p < .05$

Figure 3. Mistrust Messages Mediation Model

Figure 3. Standardized Regression Coefficients for the relationship between STEM mistrust messages and math-science grades as mediated by STEM academic self-concept. Standardized Regression Coefficients between STEM mistrust messages and math-science grade, controlling for STEM academic self-concept, is in parentheses.

*p < .05

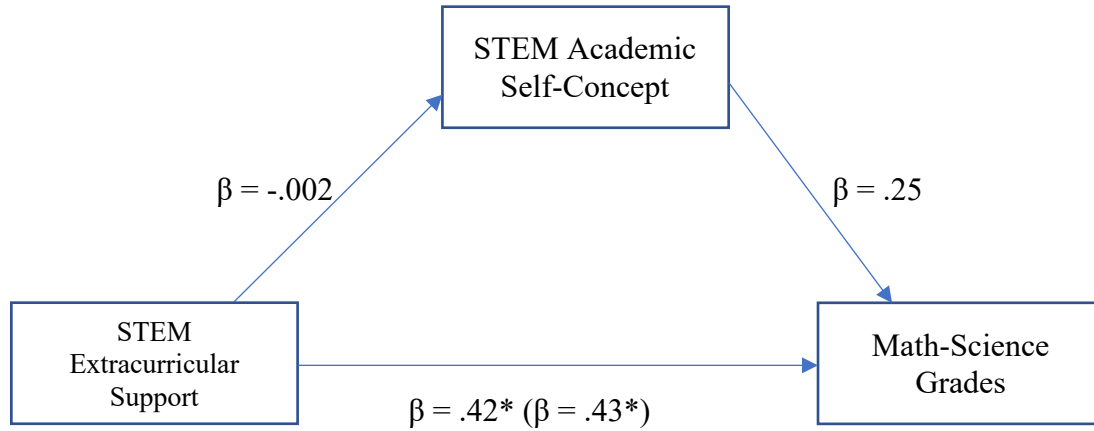Figure 4. Extracurricular Support Mediation Model

Figure 4. Standardized Regression Coefficients for the relationship between STEM extracurricular support and math-science grades as mediated by STEM academic self-concept. Standardized Regression Coefficients between STEM extracurricular support and math-science grade, controlling for STEM academic self-concept, is in parentheses.

*p < .05

Appendix A

Parent STEM Racial Socialization Scale

The following is a list of things that some parents do. Please indicate how frequently you have

engaged in each over the past year.

STEM Racial Socialization

Scale	Subscale	Item
	Racial Pride	13) Discussed Famous Black scientists with Target Child.
		14) Visited museums that have exhibits on Black accomplishments in science and math with Target Child
		15) Talked to Target Child about the importance of Blacks contributing to scientific knowledge.
		16) Tried to counter negative stereotypes about Blacks' math abilities in conversations with Target Child.
		17) Pointed out successful Black people in science and/ or math fields to the Target Child.
	Prep for Bias	18) Told the Target Child that he/she may not be called on in math class because he/she is Black.
		19) Told the Target Child that Blacks are less likely to be recommended for advanced math and science courses than Whites of similar ability.
Racial Socialization		20) Told the Target Child that teachers may have low expectations for his/her science performance because he/she is Black.
		21) Told the Target Child that there are few Black scientists because people think they are not as capable.
	Negative/Mistrust	22) Told the Target Child that Blacks are not as good in science as Whites or Asians.
		23) Discouraged the Target Child from taking advanced math courses because Black people tend to not do well in them.
		24) Told the Target Child that Blacks have not contributed much to science.
		25) Told the Target Child that it is more appropriate for Whites and Asians to pursue careers in science and technology.
		26) Told the Target Child that math skills do not come naturally for Blacks.

28) Told the Target Child Blacks should not trust technology.

29) Told the Target Child Blacks have not benefited from advancement in science and technology.

STEM Extracurricular Support

The following is a list of things that some parents do. Please indicate how frequently you have

engaged in each over the past year.

Extracurricular Support

Scales	Items
Extracurricular Support (PSES)	1) Enrolled Target Child in science/math summer camps.
	2) Enrolled Target Child in science/math after school activities or clubs (e.g., Science Olympiad).
	3) Purchased math or science computer or video games for Target Child.
	4) Purchased science workbooks for Target Child.
	5) Purchased math or science computer or video games for Target Child.
	6) Purchased board games involving math skills (e.g., Yahtzee, Monopoly) for Target Child.
	7) Purchased science/lab kits (e.g., chemistry sets, telescope, microscope) for Target Child.
	8) Purchased building kits (e.g., Knex, Rokenbok, Geomags, erector sets) for Target Child.
	11) Made books about science available for Target Child -- either purchased or from the library.
	9) Encouraged technology after-school activities or clubs (e.g., computers, iPad) for Target Child's learning.
	10) Encouraged technology after-school activities or clubs (e.g., robotics, computer club) to Target Child.
	12) Helped Target Child develop a science project (e.g., science fair, for fun).

Appendix C

Student STEM Academic Self-Concept

Please answer the questions below comparing yourself to your peers (i.e., other children your age).

	Far Below Average (1)	(2)	(3)	(4)	(5)	(6)	(7)
In MATH I am:							
In SCIENCE I am:							