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Fostering Tomorrow's Black STEM Entrepreneurs: Insights from an Innovative STEM Program Promoting Equity-Centered Entrepreneurship

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ABSTRACT:

The representation of Black students in STEM entrepreneurship remains disproportionately low, with only 2% of Black recipients of science and engineering PhDs in 2017 pursuing entrepreneurial careers. This disparity is compounded by systemic barriers faced by entrepreneurs of color, including limited access to entrepreneurship education, capital, networks, and role models/mentors. To address these challenges, we developed the STEM Racial Equity and Entrepreneurship (STEM-RAEE) program, funded by the National Science Foundation (NSF), aimed at recruiting and supporting racially minoritized students, particularly Black/African American students, from Historically Black Colleges and Universities (HBCUs). STEM-RAEE provides a holistic support system, including workshops, mentorship opportunities, and business coaching, to empower racially minoritized students to pursue entrepreneurship and contribute to a more equitable STEM ecosystem. The survey conducted as part of this research initiative seeks to understand the unique barriers and motivations of Black/African American undergraduate students in STEM and inform the development of tailored interventions through the STEM-RAEE program. With the overarching goal of fostering diversity, equity, and inclusion in the engineering and computing professions, our research aims to empower racially minoritized students to leverage their STEM knowledge for entrepreneurial success and community impact. We employed an online survey instrument, integrating constructs from empirically validated scales in entrepreneurship literature, to gather insights from 86 undergraduate STEM majors enrolled at two HBCUs in the Southern region of the United States. The survey assessed various factors, including intent to pursue entrepreneurship, self-efficacy in entrepreneurship, role models in entrepreneurship, barriers to pursuing entrepreneurship, minority status stress, levels of racial activism, and commitment to promoting equity and racial and social justice in their communities and future work in STEM. Our results indicate that students with high self-efficacy and a drive for racial and social justice are more likely to pursue entrepreneurship. Likewise, barriers related to financial capital and race-related discrimination in the entrepreneurial ecosystem remain the top-rated obstacles. Similarly, family members are a significant source of inspiration for approximately 50% of students. On the other hand, for those without personal connections, addressing social and racial inequities within their communities remains a key motivator. Together, these findings suggest that entrepreneurship initiatives targeting racially minoritized students should prioritize integrating racial and social justice principles to foster a strong entrepreneurial drive. Moreover, our research highlights the need for tailored programs, such as STEM-RAEE, which can significantly promote diversity, equity, and inclusion within engineering and computing professions.

INTRODUCTION

Background

A pressing issue in both STEM higher education and entrepreneurship is the underrepresentation of Black students, with only 2% of Black recipients of science or engineering PhDs pursuing entrepreneurial careers in 2017 (National Science Foundation, 2019). This divide is further exacerbated by the many systemic barriers that racially minoritized entrepreneurs must face, some of which include limited access to entrepreneurship education, starting capital, networks, and role models/mentors (McGee, 2020b; see also Reuben & Queen, 2015). To address these challenges, we developed the STEM Racial Equity and Entrepreneurship (STEM-RAEE) program, funded by the National Science Foundation (NSF).

The STEM-RAEE program aims to recruit and support racially minoritized students, giving extra focus to Black/African American students from Historically Black Colleges and Universities (HBCUs), as it is a historical fact that Black undergraduate students in STEM fields are an under-resourced population in STEM entrepreneurial education. This is compounded by the fact that many HBCUs do not have dedicated programs in place to support entrepreneurship within their engineering and science departments – rather, they are usually located in business-related departments (Fairlie & Robb, 2007; see also Reuben & Queen, 2015). To ameliorate these issues, the proposed program provides an encompassing support system and includes facets like workshops, mentorship opportunities, and business coaching to empower racially minoritized students and support them on their journey to pursue STEM entrepreneurship. In doing so, we hope to contribute to a more equitable STEM ecosystem.

The current research seeks to accomplish two main goals. First, we aim to identify the unique barriers that Black/African American undergraduate students face with regard to entrepreneurship. Additionally, we aim to discern any unique motivation that these students may have when choosing STEM entrepreneurship as a career path. Second, we seek to utilize these insights to inform the creation of specialized, targeted interventions for such students via the STEM-RAEE program. At a high level, this is designed to foster diversity, equity, and inclusion in the computing and engineering professions with the ultimate goal to empower racially minoritized students to use their STEM knowledge for entrepreneurial success and positive community impact.

The STEM-RAEE program recognizes that promoting entrepreneurial success among racially minoritized students requires more work than just providing technical background. It requires a holistic approach that addresses the unique social, economic, and cultural factors surrounding the landscape of STEM entrepreneurship as it exists for racially minoritized students. The proposed program integrates aspects of community engagement and social responsibility into the curriculum and aims to empower participants to leverage their diverse perspectives and experiences as strengths in the entrepreneurial ecosystem.

This study is particularly timely and significant given the current landscape of STEM entrepreneurship: despite structural barriers, entrepreneurial aspirations in the Black/African American community remain high. Data from the Founder Institute shows that African American women are the fastest growing population of entrepreneurs in the United States – Black women's business ownership increased by 164 percent from 2007 to 2018 (The Founder Institute, 2020). Additionally, data shows that African American students are 1.79 times more likely to pursue

entrepreneurship when compared to White students from similar socio-economic backgrounds (Bates et al., 2018). While this growth is promising, there has not been a corresponding increase in African American representation within startups and many minority entrepreneurs report that they feel discouraged when attempting to provide products and services to non-minority clients because of racism (Conley, 2018).

Higher education plays a critical role in fostering interest in entrepreneurship, but empirical evidence suggests that attainment of post-secondary education does not have a statistically significant effect on increasing entrepreneurial pursuits for racially minoritized students – in particular, Latinx and African American graduates (Bates et al., 2018). This speaks to the need for more targeted interventions and support systems like STEM-RAEE that are specifically designed for racially minoritized groups that are in STEM fields.

Another example of the barriers that Black STEMmers face manifest in the U.S. patent system which has been historically difficult for Black inventors to access. Data from the US Patent and Trademark Office (USPTO) shows that in the period between 1969 and 2012, HBCUs were granted only 101 patents (Donastorg, 2021) – a number that is significantly lower than what the most elite universities are granted in a single year (in 2017, MIT was granted 306 patents, and the University of California Public School System had 524). This underrepresentation means the U.S. is missing out on significant inventions and innovations, and is an example of an area that the STEM-RAEE program can have significant impact in. Racially minoritized STEM academics have been shown to be less likely to discuss their inventions or seek patents on them, and a large part of this can be attributed to a lack of access to quality mentors or support networks (Thursby et al., 2009). STEM-RAEE has the potential to increase the number of patents held by racially minoritized STEM entrepreneurs, thus contributing to closing the patent gap and fostering greater innovation diversity.

The STEM-RAEE program aims to address this by providing a more comprehensive support system than traditional entrepreneurship education, as well as encouraging an "entrepreneurial identity." Encouraging this identity is key because societal stereotypes and lack of visible role models may cause burgeoning minority entrepreneurs to have doubts that they can be a successful entrepreneur. By implementing principles of social justice and racial equity, STEM-RAEE is able to cultivate a robust entrepreneurial drive within participants while also addressing the systemic inequalities in the STEM ecosystem.

Theoretical Framework

The theoretical framework that underlies this research integrates several concepts and theories that are necessary to contextualize the challenges faced by racially underrepresented students in STEM entrepreneurship. We place a special focus on concepts that shed light on the motivating factors that would lead a STEM entrepreneur to take interest in using their knowledge to address racial inequities and create positive social change in their communities.

The central concept in this framework is Equity Ethics, developed and created by Dr. Ebony O. McGee. Equity Ethics is described as one's principled concern for racial and social justice as well as the well-being of people or groups suffering from various inequities (McGee & Bentley, 2017). This is especially relevant to our research, which posits that many underrepresented racially minoritized groups (URMs) in STEM fields who have experienced inequities wish to challenge said inequities through their work and ventures.

Equity Ethics argues that social entrepreneurship (entrepreneurship that is focused on creating positive social or environmental impacts alongside financial gain) alone does not provide a fully comprehensive tool to explain how URMs in STEM develop an interest in racial justice and addressing racial inequities both inside and outside of their STEM education and work. (McGee et al., 2022). Instead, Equity Ethics provides us with a more nuanced approach, incorporating both historical and ongoing context for how inequities shape the motivations and aspirations of URMs in the STEM ecosystem. It recognizes that for many individuals within these groups, personal experiences with inequities and discrimination fuel a desire to create meaningful change through their work.

Equity Ethics is a framework that is built to acknowledge the history of racial inequities, from the enslavement of African peoples in early America all the way to contemporary racism today. Many URMs who achieve success, particularly within the STEM fields, often feel that it is their obligation to ensure the success of younger and older generations and thus utilize their skills or positions to attempt to push the STEM field in a more equitable, inclusive direction (McGee 2020a). This brings us to a concept within our framework of Equity Ethics – linked fate – the feeling that one's fate or future is affected by what happens to other URM members within the STEM community. This recognition that the consequences of collectively shared oppression can be relevant to one's own future presents a powerful motivator to engage in entrepreneurial endeavors with the goal of addressing systemic inequities. Linked fate fosters a sense of community and collective action among URMs in STEM, encouraging collaboration and the formation of support networks. This concept also highlights the importance of representation and visibility in STEM entrepreneurship, as success stories within the community can inspire and empower others to pursue similar paths. The concept of linked fate is a principal motivating factor within the Equity Ethics framework for URM entrepreneurs to want to create social change with their work.

The intersection of Equity Ethics and STEM entrepreneurship serves to highlight the importance of good mentorship and role models within URM STEM communities. Successful entrepreneurs who embody Equity Ethics can become figures of inspiration for aspiring students. This cyclic process of repeated mentorship and inspiration contributes to the growing ecosystem of equity-minded STEM entrepreneurship.

Purpose & Research Questions

Our study seeks to address the unique challenges faced by Black/African American undergraduate students in STEM entrepreneurship and to develop targeted solutions. By identifying specific barriers and motivations within this demographic, we aim to enhance the STEM-RAEE program and better address these issues. The following results and discussion provide insights from our research that will guide the creation of tailored interventions to increase diversity in the STEM entrepreneurship ecosystem.

Utilizing pilot survey data from over 80 Black/African American students across two HBCUs, our analysis focused on three primary research questions:

1. **Barriers:** What specific barriers do students anticipate encountering that may hinder their pursuit of entrepreneurship within the STEM field?
2. **Role Models:** Who do students identify as their primary role models or personal connections within the entrepreneurial sphere? For those lacking such role models, what are the predominant motivational factors driving their interest in entrepreneurship?
3. **Psychosocial Factors Influencing Intent**: What psychosocial factors significantly predict, or are associated with, students' intentions to pursue entrepreneurship?

METHODS

To address our research question, we designed and delivered the "Rising Entrepreneurs: Exploring Student Perspectives on Entrepreneurship" Survey (Rising Entrepreneurs). This survey is an online instrument consisting of constructs from empirically validated scales widely used in the entrepreneurship literature. Human subjects' approval was received by the first author's home institution's institutional review board and informed consent was recorded from all respondents prior to data collection and analysis.

Instrument Design

The scales for the Rising Entrepreneurs Survey were designed to align with our research objectives, focusing on assessing attitudes, perceptions, motivations, and intentions among URM students in STEM. Specifically, the survey explored constructs such as Entrepreneurial (ENT) Intent and Aspirations, ENT Self-efficacy, Perceived Barriers, Role Models, Equity Ethics, Minority Status Stress, and Racial Activism for URM nascent entrepreneurs in STEM fields.

To ensure the reliability and validity of our constructs, we conducted a comprehensive reliability analysis using Cronbach's alpha. The computed alphas for our multi-item constructs were as follows:

- **ENT Intent** (Fredericks et al., 2005; Cardon et al., 2013; Linan & Chen, 2009) (9 items; $\alpha = 0.94$), which included items like, "I have a strong interest in entrepreneurship."
- **ENT Self-efficacy** (McGee et al., 2009) (6 items; $\alpha = 0.88$), e.g., "I am confident in my ability to generate innovative business ideas."
- **ENT Passion** (Cardon et al., 2013) (3 items; $\alpha = 0.78$), e.g., "Searching for new ideas for products/services to offer is enjoyable to me."

- **Equity Ethics** (McGee et al., 2022) (10 items; α = 0.95), e.g., "I know that my responsibility is to challenge gatekeeping mechanisms that keep marginalized groups out of STEM fields."
- **Role Models** (Nauta & Kokaly, 2001) (3 items; α = 0.90), e.g., "There is an entrepreneur I look up to as a role model."
- **Minority Status Stress** (Smedley et al., 1993) (10 items; α = 0.90), e.g., "How stressful has the following situation been for you: Being treated rudely or unfairly because of my race?"

The **Racial Activism** scale (α = 0.94), adapted from Szymanski (2012), was originally designed to measure African-American activism. We modified it to be inclusive of all racial groups, substituting "African-American" with "People of Color" (e.g., "I attend conferences/ lectures/ classes/ trainings on issues pertaining to People of Color"). Additionally, we developed a new measure called "**Equity-Driven Aspirations**," a variation of the Equity Ethics scale, designed to assess the extent to which students are motivated to pursue entrepreneurship as a means to address social and racial injustices (5 items; α = 0.91), e.g., "I am motivated to use entrepreneurship to actively promote racial and social justice."

Additional constructs included:

- Barriers to Entrepreneurship: Assessed the extent to which students perceive various obstacles to founding a business (e.g., "Please indicate the extent to which each of the following factors acts as a barrier to your pursuit of entrepreneurship as a career: Lack of mentors, etc.").
- ENT Activities: Evaluated whether students have engaged in activities that would prepare them to found a business in the near future (e.g., "Have you participated in any of the following activities, either currently or in the past: Saved money to invest in a business, etc.").

The survey also captured demographic information aligned with the U.S. Census Bureau, including race/ethnicity, sex and gender identity, and disciplinary background. Open-ended questions were included to assess students' personal connections to entrepreneurs or role models who may influence their perspectives on entrepreneurship.

Recruitment & Administration

Our recruitment strategy targeted URM STEM students at two HBCUs: a private HBCU and a public HBCU in a Southern state in the United States. The survey was administered in two classrooms at the respective institutions, where students were asked to complete the survey at the beginning of class via an online link. A total of 108 students responded to the survey. Of these, 12 students who answered less than 50% of the survey were removed from the dataset. Additionally, 10 students who either provided the incorrect university or were suspected of not being students were directed out of the survey. Our final dataset was comprised of 86 students.

Demographic Characteristics

Of the 86 students in our final dataset, 14 (16%) identified as male, 70 (81%) as female, and 2 (2%) opted not to respond (e.g., "prefer not to answer"). Additionally, with the exception of 3 students,

all participants identified as African American or Black (83; 97%). Among the 3 students who did not identify as African American or Black, 2 (2%) identified as White, and 1 (1%) chose not to respond. Similarly, the vast majority of students indicated that they were U.S. citizens (83; 97%), with 2 (2%) indicating that they were not, and 1 choosing not to respond. Regarding academic status, 12 students identified as first-year students (14%); 36 as sophomores (42%); 22 as juniors (26%); 15 as seniors (17%); and 1 student who selected "Other" (1%) specified that they were a fifth-year student pursuing a dual Bachelor's/Master's degree.

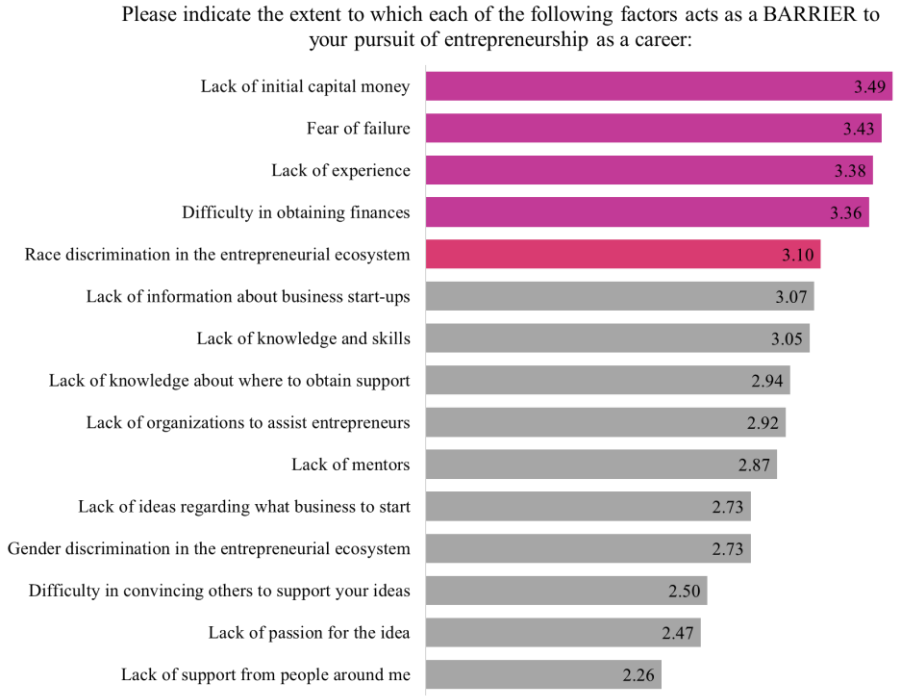
RESULTS

The analysis is presented in three parts. First, descriptive statistics of the **barriers** students anticipate encountering are outlined. Next, qualitative coding of students' responses to open-ended questions concerning their **role models** in entrepreneurship is discussed. Finally, a multiple linear regression and a correlation matrix examine the relationship between our psychosocial variables (e.g., ENT Self-Efficacy) and students' **intentions to pursue entrepreneurship** (i.e., ENT Intent). Statistically significant relationships are highlighted, followed by their implications in the Discussion section.

Barriers

When asked to rate factors related to barriers to pursuing entrepreneurship as a career on a scale from 1 (no barrier) to 5 (extremely high barrier), the mean scores are presented in Figure 1. Figure 1 indicates that the top-rated barriers include: lack of initial capital (Mean = 3.49, SD = 1.08), fear of failure (Mean = 3.43, SD = 1.23), lack of experience (Mean = 3.38, SD = 1.10), and difficulty in obtaining finances (Mean = 3.36, SD = 1.12). These results suggest that students perceive financial investment challenges and fear of failure due to insufficient experience as significant obstacles. Additionally, while not among the top four barriers, concerns about racial discrimination in the entrepreneurial ecosystem were rated as a moderate barrier (Mean = 3.10, SD = 1.17), highlighting an awareness of race-related challenges. This rating underscores the importance of addressing systemic inequalities that may affect entrepreneurial opportunities for URM STEM students.

Figure 1. Barriers (mean scores)

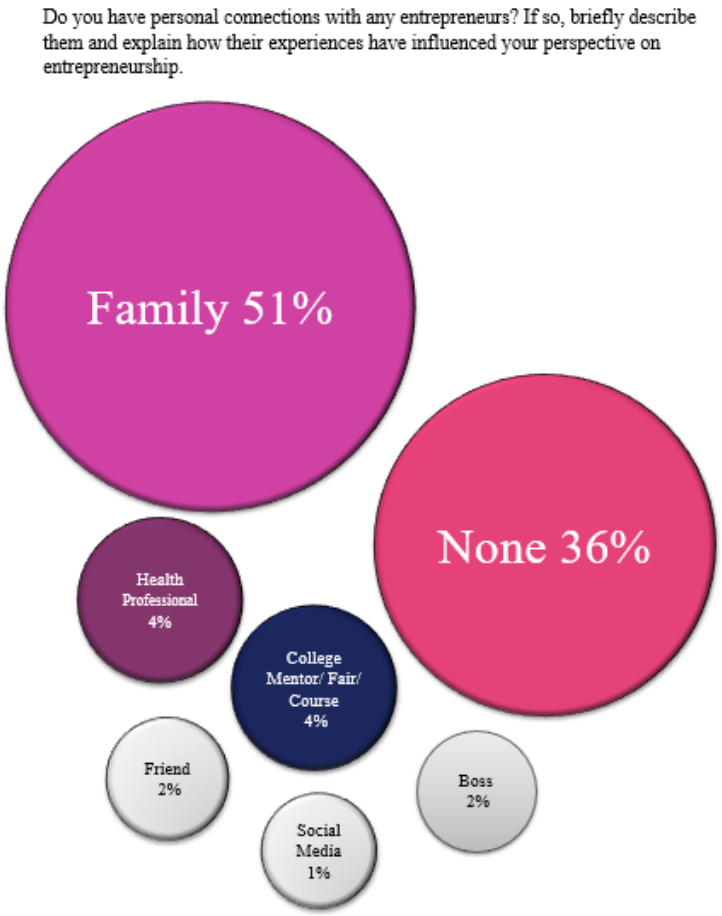


Note. Scale, 1, no barrier to 5, extremely high barrier. N=86. Top 4 barriers are highlighted in purple, and race discrimination barrier is highlighted in pink for reference.

Role Models

Students' responses to the open-ended question about their personal connections with role models (e.g., “Do you have personal connections with any entrepreneurs? If so, briefly describe them and explain how their experiences have influenced your perspective on entrepreneurship.”) were categorized into types of role models. For instance, students who referred to a family member (e.g., “My aunt sparked my interest in entrepreneurship because she runs her own business and earns a decent income from it.”) were designated as having a "Family" role model. The findings, presented in Figure 2, reveal that 51% of students identified a family member as their personal connection to entrepreneurship, 36% reported having no personal connection or indicated "none," 4% mentioned a health professional (e.g., doctor, dentist), 4% referred to a college mentor or a college fair/course that influenced their perspective, 2% cited a current or former boss, 2% mentioned a friend, and 1% followed an entrepreneur on social media. These results highlight that family members are the predominant source of inspiration for students’ entrepreneurial interests.

Figure 2. Role Models



Thematic analysis (Miles & Huberman, 1994) was utilized to examine responses from individuals who indicated "none" or who did not have a personal connection to a role model in the entrepreneurial space. A prominent theme that emerged was the desire to address and promote equity. For example, one student noted, "I don't have a personal connection with a role model. However, my interest in entrepreneurship is driven by a problem I faced; I want to provide products to people who look like me." This response highlights a commitment to addressing disparities through entrepreneurial endeavors. Similarly, another student stated, "No connections at this moment. But living in food deserts has motivated me to pursue a degree in Agriculture to make a positive change in my own environment." These statements reflect a broader theme of leveraging entrepreneurship to foster community equity and improve local conditions. Overall, the thematic analysis reveals that while these students may lack personal role models, their entrepreneurial aspirations are deeply influenced by a desire to create equitable solutions and address community needs.

Intentions to Pursue Entrepreneurship

Multiple linear regression was employed to examine the influence of key psychosocial variables on students' intentions to pursue entrepreneurship (ENT Intent). The overall regression model was statistically significant ($R^2 = .52$, $p < .01$), indicating that the predictor variables collectively explained a substantial portion of the variance in ENT Intent. Among the individual predictors, ENT Self-Efficacy ($\beta = .27$, $p < .05$) and Equity Aspirations ($\beta = .30$, $p < .01$) emerged as statistically significant contributors to ENT Intent. Although not statistically significant at $p < .05$, Minority Status Stress ($\beta = .15$, $p < .01$) approached significance, suggesting that race-related stress plays a role in motivating individuals toward entrepreneurial pursuits. When rank ordering the β-weights, or standardized Betas, Equity Aspirations emerges as the top-ranked predictor, indicating that it has the strongest and most consistent relationship with ENT Intent among the included variables. This suggests that students' desire to create equitable businesses is a particularly powerful predictor of their entrepreneurial intentions.

Table 1. Regression Model

Outcome Variable: ENT Intent					
	B	Std. Error	Beta (β)	t	Sig.
(Constant)	0.08	0.47		0.18	
ENT Self Efficacy	0.33	0.15	0.27	2.23	0.029*
ENT Passion	0.27	0.16	0.23	1.72	0.089
Equity Aspirations	0.37	0.14	0.30	2.66	0.009**
Equity Ethics	-0.16	0.09	-0.15	-1.87	0.065
Minority Status Stress	0.12	0.06	0.15	1.97	0.053
R-squared=.52					

Note. *p<0.05, **p<0.01. Statistically significant predictors are highlighted in green.

The correlation matrix presented in Table 2 provides insights into the relationships between various survey variables and ENT Intent. Once again, ENT Self-efficacy (r=.66, p<.01) and Equity Aspirations (r=.62, p<.01) are statistically significantly related to ENT Intent. In addition, Role models, ENT Passion, and Minority Status Stress are also related to ENT identity. This suggests that having a role model, possessing a passion for developing new ideas for products and services, and experiencing race-related stress play important roles in shaping URM students' entrepreneurial identities.

Table 2. Correlation Matrix

	ENT Intent	ENT Self-Efficacy	ENT Passion	Equity Aspirations	Role Model	Racial Activism	Equity Ethics	Minority Status Stress
ENT Intent	1							
ENT Self-Efficacy	.656**	1						
ENT Passion	.663**	.762**	1					
Equity Aspirations	.615**	.627**	.709**	1				
Role Model	.510**	.486**	.506**	.473**	1			
Racial Activism	0.039	0.032	0.051	0.204	.228*	1		
Equity Ethics	-0.054	-0.033	0.057	.238*	-0.048	.464**	1	
Minority Status Stress	.250*	0.146	0.173	0.158	.337**	.243*	0.168	1

Note. Pearson's Correlations are displayed above. *p<0.05, **p<0.01. Statistically significant correlation values are highlighted in green.

DISCUSSION

The findings from our pilot survey of 86 undergraduate STEM majors enrolled at two HBCUs in the southern United States provide valuable insights into their unique barriers and motivations towards pursuing entrepreneurship. Notably, financial barriers, such as lack of initial capital and difficulty obtaining finances, were identified as the most significant obstacles to entrepreneurship. These findings underscore the urgent need for financial resources and support mechanisms tailored to the needs of racially minoritized students in STEM. Additionally, the concern about racial discrimination in the entrepreneurial ecosystem highlights the pervasive impact of systemic racism on the entrepreneurial aspirations of URM students. However, several of the top barriers identified in this study, such as the fear of failure, are not unique to URM students. Research by Brown & Rees-Jones (2024) shows that even high-growth businesses and founders of all racial and ethnic backgrounds struggle with the fear of failure, indicating that this is may be a universal challenge.

Our findings also highlight the critical role that family members play. Specifically, over half of the students in our sample identified a family member as their inspiration for pursuing entrepreneurship. This underscores the importance of familial support in shaping entrepreneurial intent for URMs. However, for students lacking personal connections to entrepreneurs, their motivation was driven by a desire to address social and racial inequities within their communities. This finding suggests that entrepreneurship initiatives targeting racially minoritized students should incorporate social entrepreneurship principles that align with their aspirations to create equitable solutions and foster community impact.

Additionally, psychosocial factors such as entrepreneurial self-efficacy and equity aspirations were found to be significant predictors of entrepreneurial intent. The strong relationship between equity aspirations and entrepreneurial intent indicates that students who are motivated to address social and racial injustices are more likely to pursue entrepreneurial careers. This aligns with the broader

goals of the STEM-RAEE program which seeks to empower racially minoritized students to leverage their STEM knowledge for both entrepreneurial success and community impact.

Given that this was a pilot survey, our next steps include expanding our research to a wider range of institutions across the United States, including Predominantly White Institutions (PWIs), Hispanic-Serving Institutions (HSIs), and more HBCUs, to assess whether these findings hold true across a broader spectrum of racial and ethnic groups. By disseminating the survey across these different types of institutions, we aim to also investigate differences between URM and nonURM students to examine both universal themes and race-specific challenges that may be unique to URM nascent entrepreneurs.

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