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Colliding identities? The role of multiple identities among historically underrepresented students pursuing scientific research careers

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ABSTRACT

Motivated by Identity Integration and Threat theories, this preregistered study examined associations between scientist and ethnic identities and future scientific research career intentions among African American and Hispanic STEM undergraduates ($N = 1,247$). Scientist identity was positively correlated with junior-year ethnic identity and predicted senior-year scientific research career intentions. Neither scientist nor ethnic identities predicted senior-year self-esteem (which may influence science career decisions). However, minority science training program (MSTP) enrollment influenced the relationship between scientist identity and self-esteem, and between ethnic identity (belongingness) and scientific research career intentions. Neither ethnicity nor gender were moderators. The results indicate that different identities can relate to one another and uniquely influence scientific research career decisions among African American and Hispanic students, especially among MSTP enrollees.

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STEM; scientist; ethnic; identity; minority

Introduction

Although it is encouraging that the proportion of African American and Hispanic people in scientific research careers increased from 18% to 24% between 2011 and 2021, they remain underrepresented relative to their proportion of the U.S. population aged 18–74 (30%) and White and Asian people (74% of people in scientific research careers but 67% of the U.S. population aged 18–74) (National Center for Science and Engineering Statistics, 2023). Addressing this underrepresentation is an urgent national priority because it has been argued that the U.S. cannot maintain its preeminence in scientific and technological innovation nor identify and address the needs and challenges of diverse populations without increasing the ethnic diversity of people in scientific research careers (Hong &

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Page, 2004; National Center for Science and Engineering Statistics, 2023; Olson & Riordan, 2012; Valantine & Collins, 2015). Because a person's social identities, or the roles or membership categories they view as an important part of who they are (Deaux, 1993), influence their behavior, motivation, and well-being (Kelman, 2006; Thoits, 1983) – an important yet frequently overlooked outcome with implications for motivation and goals (Baumeister & Tice, 1985; Lyubomirsky et al., 2005) – the social identities of African American and Hispanic STEM students could have crucial implications for whether they pursue scientific research careers. Indeed, the more that African American and Hispanic undergraduate STEM students identify as scientists, the stronger their intentions to pursue a scientific research career (Chemers et al., 2011; Estrada et al., 2011) and the likelihood they obtain one after college (Estrada, Hernandez, et al., 2018).

People have many different social identities that vary in how they relate to one another (Amiot et al., 2007). However, past research on African American and Hispanic STEM students has nearly exclusively focused on their scientist identity, and no studies have examined how any of their identities relate to their well-being, which is an outcome that may influence whether people in STEM fields pursue scientific research careers (Nature Editorial, 2020; Wilkins-Yel et al., 2022). This narrow focus indicates that our understanding of how different social identities among African American and Hispanic STEM students relate to one another and their motivations to pursue scientific research careers and well-being is quite limited.

To better understand how different social identities among African American and Hispanic STEM students relate to their decisions to pursue scientific research careers and potentially inform ways to address their underrepresentation in those careers, we conducted a longitudinal and preregistered study.¹ This study examined the scientist and, for the first time, ethnic identities, of 1,247 African American and Hispanic undergraduate STEM students. Specifically, motivated by Identity Integration (e.g., Amiot et al., 2007) and Threat (e.g., Cohen & Garcia, 2008) theories, we examined how these identities related to one another and students' intentions to pursue a scientific research career and, for the first time, their well-being via self-esteem one year later. We also examined whether these relationships were influenced by ethnicity (African American vs. Hispanic), gender, or enrollment in minority science training programs.

Scientist and ethnic identities: Relations with one another

According to Identity Theory and Social Identity Theory (Hogg et al., 1995) and Kelman's (2006) social influence model, identities are developed and sustained within relationships with others. For example, when STEM students behave like scientists (e.g., conduct scientific research, perform well in science courses), members of the academic and scientific community (e.g., professors and lab PIs) reinforce and encourage future instances of scientist-like behavior by providing social rewards like good grades, praise, or additional opportunities to conduct research in labs (Estrada et al., 2011). Because these social rewards are highly desirable and often necessary to succeed in STEM programs, students will, over time, begin to identify as scientists (e.g., Estrada, Young, et al., 2019; Estrada, Zhi, et al., 2019) and, therefore, more naturally behave like one to maintain the relationships that afford the social rewards (Kelman, 2006). In contrast, if students are not given sufficient reinforcement, recognition, and/or perceive that they are not welcome by

members of the academic and scientific community, they are unlikely to identify as scientists and may end up leaving STEM fields altogether (Cohen & Garcia, 2008; Estrada, Eroy-Reveles, et al., 2018).

However, STEM students' scientist identity is not their only identity. Amiot and colleague's (2007) Model of Social Identity Development and Integration posits that people's different identities can complement one another when they are socially supported. However, when identity threats are perceived, different identities can interfere with one another or become highly differentiated and isolated. This is relevant to African American and Hispanic STEM students because they inhabit an academic environment in which their ethnic groups have historically been underrepresented, negatively stereotyped by others (e.g., "intellectually inferior"), and not socially supported to the same extent as White and Asian students (McGee, 2016; Thiry et al., 2019). In other words, their scientist and ethnic identities, or the extent they have explored as well as feel a sense of belonging with their ethnic group (Phinney & Ong, 2007), could relate to one another in important ways.

Although the relationship between these identities has not yet been empirically examined, some qualitative interviews suggest they could interfere with one another and be negatively linked. For example, the physical attributes (e.g., skin color) of African American and Hispanic people often make their ethnicity a primary identity through which others see them especially if few others share their ethnic background (Chandra, 2006; McGee, 2016). Because their ethnic groups are negatively stereotyped as not being as smart or warm as others, African American and Hispanic STEM students report receiving less recognition for their achievements and fewer social and research rewards and opportunities (Malone & Barabino, 2009; McGee, 2016). These unfortunate situations can lead students to feel invisible and in-turn question their ability to become capable scientists as well as question the compatibility of their scientist and ethnic identities (e.g., feel like one must give one identity up for the other; Carlone & Johnson, 2007; Cohen & Garcia, 2008; Malone & Barabino, 2009).

However, other qualitative interviews and research suggest that these identities might remain separate or even complement one another (i.e., no or a *positive* relationship, respectively). For example, African American and Hispanic STEM students interviewed by McGee (2016) reported using coping strategies to protect and sometimes alter, but not disidentify with, their ethnic group when they were negatively stereotyped. One coping strategy – termed *frontin'* – involved engaging in stereotypical ethnic behaviors as an act of defiance to show they could be a minority yet successful even if they typically do not act that way. *Frontin'* earned some students recognition for their scientist-like behaviors, potentially facilitating a stronger scientist identity, while not changing or increasing the extent to which they identified with their ethnic group. Despite sometimes feeling inauthentic, other students McGee (2016) interviewed reported fostering their scientist identity while maintaining their ethnic identity by acting "White" in certain situations because others perceived being "White" as more compatible with being a scientist than someone from their ethnic group. Strategically behaving like a scientist and/or person of their ethnic group depending on whether they believed those identities could elicit social recognition and rewards was another strategy used (Malone & Barabino, 2009; McGee, 2016). Although women are underrepresented and negatively stereotyped in STEM fields like African American and Hispanic students (Blackburn, 2017), the scientist and women identities of White

women enrolled in STEM programs are positively related to one another (Settles, 2004) and changes in them over time are positively related as well (Settles et al., 2009). Though the woman identity of a White woman is likely less stigmatized and negatively stereotyped than an African American or Hispanic ethnic identity, this research at least indicates that a person's scientist identity can positively relate to an underrepresented and negatively stereotyped identity.

Although the exact nature of the relationship between the scientist and ethnic identities of African American and Hispanic STEM students is unclear, these studies indicate that they could relate to one another.

Scientist and ethnic identities: Scientific research career intentions

Conducting scientific research is central to what professional scientists do and given that identities "imply action" (Callero, 1985, p. 205), African American and Hispanic undergraduate STEM students with stronger scientist identities report stronger intentions to pursue a scientific research career (Chemers et al., 2011; Estrada et al., 2011). However, does the strength of their ethnic identity also relate to their intentions to pursue a scientific research career? Research has yet to examine their relationship, but qualitative interviews and other research suggest the nature of the relationship could be positive, negative, or null.

In terms of a positive relationship, many African American and Hispanic students pursue higher education to achieve communal and prosocial goals such as to give back to their families and ethnic communities or to make them proud (Boucher et al., 2017; Estrada, Eroy-Reveles, et al., 2018; McGee, 2016). Because a key function of social identities is to provide people with a sense of purpose, direction, and meaning in life (Thoits, 1983), the ethnic identity of African American and Hispanic STEM students could facilitate a sense of purpose and motivation to pursue a scientific research career and achieve their communal and prosocial goals. Reviews and meta-analyses support this suggestion insofar as they have found that the ethnic identity of African American and Hispanic students predicts stronger academic motivation and persistence (Destin & Williams, 2020; Rivas-Drake, Seaton, et al., 2014; Umaña-Taylor, 2011), and they are more likely to pursue scientific research careers when STEM fields afford the achievement of communal and prosocial goals (Boucher et al., 2017).

In terms of a negative relationship, the ethnic groups of African American and Hispanic students in STEM fields are historically underrepresented and often negatively stereotyped by others. These factors can have detrimental effects on students' motivation. For example, according to Cohen and Garcia's (2008) Identity Engagement Model, negative stereotypes heighten the salience of students' identities and make them vigilant for identity-related threats. This vigilance can undermine students' sense of belonging and cause performance decrements, and, over time, this can become a negative feedback loop wherein students disidentify with the threatened identity or leave the threatening environment to eliminate the feedback loop (e.g., leave STEM fields) (Cohen & Garcia, 2008; Steele, 1997). Indeed, some African American and Hispanic STEM students McGee (2016) interviewed reported that having to frequently cope with ethnic-related threats and discrimination as well as pretend to be "White" made them question whether they belonged in STEM fields.

Another possibility is that students' ethnic identity might not relate to their intentions to pursue a scientific research career, at least not directly. As we reviewed in the prior section, students' scientist and ethnic identities might relate to one another in important ways. This could mean that students' ethnic identity might relate to their intentions to pursue a scientific research career indirectly *through* students' scientist identity. Yet another possibility is that students' ethnic identity might not directly relate to their intentions to pursue a scientific research career because a recent review indicated that contextual factors often influence how the ethnic identity of African American and Hispanic students relates to their academic persistence and motivation (e.g., the culture of the academic environment or perceptions of negative stereotypes; Destin & Williams, 2020). For example, one study found that the ethnic identity of Hispanic college students was positively related to negative perceptions of their academic environments which in turn was related to weaker motivations to finish college (Castillo et al., 2006).

Taken together, the scientist identity of African American and Hispanic STEM students positively relates to their intentions to pursue a scientific research career, but how their ethnic identity relates to their intentions to pursue a scientific research career is unclear.

Scientist and ethnic identities: Self-esteem

As central aspects of who one is, many theories involving social identities discuss the crucial role that social identities have in shaping a person's well-being and, more specifically, their self-esteem or global evaluation of themselves (Martiny & Rubin, 2016; Tajfel & Turner, 1979; Thoits, 1991). Well-being and self-esteem are important because they are crucial components of a person's overall mental health (Fusar-Poli et al., 2020). However, they are also important because they motivate people to more actively and successfully work toward new goals that "broaden and build" one's skills and abilities (Fredrickson, 2001; Lyubomirsky et al., 2005). For example, people with high self-esteem seek out opportunities that develop their strengths (e.g., pursuing a scientific research career), whereas people with low self-esteem focus on alleviating their deficiencies to satisfactory or adequate levels (e.g., just focusing on passing classes) (Baumeister & Tice, 1985). This could suggest that the well-being and self-esteem of STEM students could have implications for their motivations to stay in STEM fields and pursue a scientific research career. Indeed, each of the seven African American and/or Hispanic STEM graduate students Wilkins-Yel and colleagues (2022) interviewed reported that they considered dropping out of their program because of well-being concerns (three did drop out). Further, 51% of the more than 7,600 post-doctoral students across 19 STEM fields and 93 countries polled by the journal *Nature* reported that they had considered leaving active research because of well-being concerns (Nature Editorial, 2020).

Because behaving like a scientist generally earns recognition and social rewards from others in STEM fields, the scientist identity of African American and/or Hispanic STEM students likely positively relates to their self-esteem. Although no research has empirically examined this relationship among these students, the scientist identity of White women in STEM fields is positively correlated with their self-esteem cross-sectionally, but, interestingly, not longitudinally (Settles, 2004; Settles et al., 2009). However, how does the ethnic identity of African American and Hispanic STEM students relate to their self-esteem? No research has empirically examined this relationship, but a critical milestone for ethnic

minority people is to identify with one's ethnic group securely, and for those who are not secure in their ethnic identity, poor psychosocial functioning can result (Phinney, 1990; Umaña-Taylor, 2011). In other words, ethnic identity might positively relate to self-esteem. A meta-analysis of 46 studies examining the relationship between the ethnic identity and self-esteem of U.S. ethnic minority youth supported this suggestion insofar as they were positively related to one another (Rivas-Drake, Syed, et al., 2014). Positive associations have also been observed among African American and Hispanic college students (Brouillard & Hartlaub, 2005; Jaret & Reitzes, 2009).

However, because stronger ethnic identities can heighten one's vigilance for the ethnic-related threats that are prevalent in STEM fields and undermine a person's well-being and sense of belonging (i.e., Identity Engagement Model; Cohen & Garcia, 2008; Thiry et al., 2019), stronger ethnic identities could lead one to perceive more ethnic identity related threats that might in-turn undermine their self-esteem. For example, McCoy and Major (2003) found that the strength of the positive relationship between perceptions of prejudice and depressive symptoms among Hispanic college students increased as their ethnic identity increased. Still, other studies have found no relationship between the ethnic identity and well-being or self-esteem of African American and Hispanic people (see, Umaña-Taylor, 2011, for a review).

While the scientist identity of African American and Hispanic STEM students likely positively relates to their self-esteem, how their ethnic identity relates to their self-esteem is unclear.

The role of sociodemographic factors

Because students' experiences in STEM fields can vary enormously, there are likely factors that influence the correlates of students' identities. One set of factors with potentially important implications is sociodemographic factors such as ethnicity, gender, and minority science training program enrollment. For example, using a subset of participants in the present study, Woodcock and colleagues (2012) found that, despite 56% of students attending a Hispanic Serving Institution, perceptions of negative stereotypes were negatively correlated with the scientist identity of Hispanic STEM students. However, the correlation was not significant among African American STEM students, but this could have been due to most of their African American students (85%) being enrolled at predominantly Black colleges. Because predominantly Black colleges have been described as "social equalizers" by providing African American students with important and ethnic-related social resources and capital as well as connections to African American peers, faculty, and their communities, negative ethnic stereotypes are likely less prevalent and salient (Allen et al., 2007). This could suggest that, compared to Hispanic students, the scientist identity of African American students enrolled at those colleges could be less threatened by negative stereotypes and differentially relate to their motivations and self-esteem. These results also suggest that, despite at least 25% of the student body at Hispanic Serving Institutions being Hispanic (Laden, 2004), negative stereotypes at these institutions might still be very prevalent and can have negative consequences for the scientist identity of Hispanic students.

In addition to institutional-level sociodemographic attributes, localized sociocultural environments can also impact learners. For example, women who encountered

stereotypical cues of computer science (e.g., Star Trek posters, video games) reported a lower sense of belonging and interest in computer science compared to women who encountered cues not considered stereotypical (e.g., nature posters, phone books) (Cheryan et al., 2009; Master et al., 2016). These manipulations did not affect men because computer science is a man-dominated field with stereotypes generally considered masculine. In some cases, minority science training programs can create micro-sociocultural environments that impact learners' identities and motivations because these programs provide socioemotional and instrumental support as they pursue their STEM degree (Matsui & Gibbs, 2018). For example, students' social connections in these programs can positively relate to their scientist identity (Estrada et al., 2021). Additionally, African American and Hispanic STEM students enrolled in a minority science training program reported higher intentions to pursue a scientific research career over time compared to a matched control group not enrolled in one (Schultz et al., 2011).

The present study

Ethnically diverse STEM fields have many benefits and increasing the representation of African American and Hispanic people in scientific research careers would greatly contribute to that diversity. Because scientist *and* ethnic identities are salient among African American and Hispanic STEM students, they could have important implications for one another, whether these students intend to pursue a scientific research career, and another potential motivating factor: their self-esteem. Thus, using a large ($N = 1,247$) longitudinal sample of African American and Hispanic undergraduate STEM students, we conducted a study in which the study design and all analyses reported in this manuscript were preregistered.² This study is the first to empirically examine the correlates of their ethnic identity as well as two identities (scientist and ethnic) simultaneously among this population. Specifically, we examined correlations between students' scientist and ethnic identities during junior year (Research Question 1; RQ1) as well as how those identities during junior year were correlated with students' intentions to pursue a scientific research career (RQ2) and self-esteem (RQ3) during senior year. We also examined whether these correlations were influenced by sociodemographic factors: ethnicity (African American vs. Hispanic), gender, and enrollment in minority science training programs (RQ4).³ Our preregistration plan, all reported data in.csv format, a codebook of all assessed variables (including those not analyzed here), and annotated R code for our research questions reported in this manuscript are available online (<https://osf.io/fgct5/>).

Method

Participants and procedure

Participants were 1,247 African American and Hispanic STEM undergraduate students recruited as a part of *TheScienceStudy*, a longitudinal panel study of 1,420 STEM students recruited from 50 U.S. universities intending to pursue a scientific research career at the time of enrollment. Beginning in 2005, students completed an online survey semiannually (during Spring and Fall) for 12 consecutive years, consented online, and received \$25 for each survey. The present study examined

data pertaining to junior and senior years in college. Fifty-six percent of students were African American, 44% were Hispanic, 73% were women, and 36% were enrolled in a minority science training program at some point as an undergraduate student. Regarding socioeconomic status, 22% of students (16% of African American students and 29% of Hispanic students) were first-generation college students. Further, 79% of African American students were enrolled at a predominantly Black college, and 53% of Hispanic students were enrolled at a Hispanic-serving institution. This study was conducted in compliance with the approved IRB protocols.

Measures

Scientist identity (junior year)

Scientist identity was measured consistent with Estrada et al. (2011). Specifically, students were asked to indicate their agreement (1=*Strongly disagree*, 5=*Strongly agree*) with five items⁴ that measured the centrality of the scientist identity ("I have come to think of myself as a Scientist"), satisfaction derived from doing scientific work ("The daily work of a scientist is appealing to me," "I derive great personal satisfaction from working on a team that is doing important research"), and feeling a sense of belonging with the scientific community ("I have a strong sense of belonging to the community of scientists," "I feel like I belong in the field of science") ($\alpha=.82$).

Ethnic Identity (junior year)

The Multigroup Ethnic Identity Measure (Roberts et al., 1999) was used to assess two facets of ethnic identity. Specifically, the *affirmation and belonging* facet (hereafter referred to as belonging) asked students to indicate their agreement (1=*Strongly Disagree*, 4=*Strongly Agree*) with seven items related to their sense of belonging with their ethnic group (e.g., "I am happy that I am a member of the group I belong to," "I have a strong sense of belonging to my own ethnic group") and the satisfaction and pride their ethnic group provides them (e.g., "I have a lot of pride in my ethnic group," "I feel good about my cultural or ethnic background") ($\alpha=.92$). The *search and exploration* facet (hereafter referred to as search) asked students to indicate their agreement with five items related to their efforts to learn about what their ethnic group means for them (e.g., "I have spent time trying to find out more about my ethnic group such as its history, traditions, and customs," "In order to learn more about my ethnic background, I have often talked to other people about my ethnic group") and their participation in ethnic-related activities (e.g., "I am active in organizations or social groups that include mostly members of my own ethnic group," "I participate in cultural practices of my own group, such as special food, music, or customs") ($\alpha=.76$).

Intentions to pursue a scientific research career (senior year)

Consistent with Estrada et al. (2011), a single item was used to assess students' intentions to pursue a scientific research career. Specifically, students were asked to indicate the extent (0=*Definitely will not*, 10=*Definitely will*) they "intended to pursue a scientific research career."

Self-esteem (senior year)

The Rosenberg Self-esteem Scale (Rosenberg, 1965) assessed students' self-esteem. Specifically, students indicated their agreement (1=*Strongly Disagree*, 5=*Strongly Agree*) with five true-keyed items (e.g., "On the whole, I am satisfied with myself") and five false-keyed items which were reversed scored (e.g., "I certainly feel useless at times") that assessed how positive their global evaluation of themselves was ($\alpha=.90$).

Sociodemographic factors

Ethnicity. Ethnicity was coded as African American = 0, Hispanic = 1.

Gender. Gender was coded as Woman = 0, Man = 1.

Enrollment in a minority science training program (MSTP). Each semester, students indicated whether they had ever enrolled in a MSTP. We considered them enrolled if they indicated being enrolled in one at any point as undergraduate students (never enrolled in an MSTP = 0, enrolled in an MSTP at some point = 1).

Data-analytic plan

The entire data-analytic plan described below (except for our removal of a single variable that did not affect our results and is fully detailed in Footnote 2) as well as all referenced guidelines were preregistered (<https://osf.io/hy9up>).

Data structure

Because *TheScienceStudy* collected data linearly (e.g., Spring 2006, Fall 2006, Spring 2007), the data were restructured based on class standing (i.e., junior Fall/Spring, senior Fall/Spring) to reflect the natural progression through college. Because some measures were only assessed once per academic year or in some academic years, we pairwise averaged each measure across each academic year (i.e., one assessment per academic year) to maximize data retention.

Statistical model

All research questions were examined using structural equation modeling, and multiple-item variables were modeled as latent variables (see Figure 1 for a visual depiction of our conceptual model and research questions). Model fit for our conceptual model (Figure 1) was good based on Hu and Bentler's (1999) recommendations (CFI=.96, RMSEA = .03, and SRMR = .04⁵). Configural and metric invariance was observed for each latent variable across our sociodemographic factors (see the online supplemental materials for methods and results for these analyses). This meant we could interpret significant differences in our observed correlations across our sociodemographic factors when examining RQ4 (Hirschfeld & von Brachel, 2014).

To examine RQ1 (How do students' scientist and ethnic identity relate to one another?), we examined the covariation between scientist identity and each facet of ethnic identity during junior year. To examine RQ2 (How do students' scientist and ethnic identity relate to their intentions to pursue a scientific research career?) and RQ3 (How do students' scientist and ethnic identity relate to their self-esteem?), we regressed intentions to pursue a scientific research career and self-esteem during senior year on scientist identity

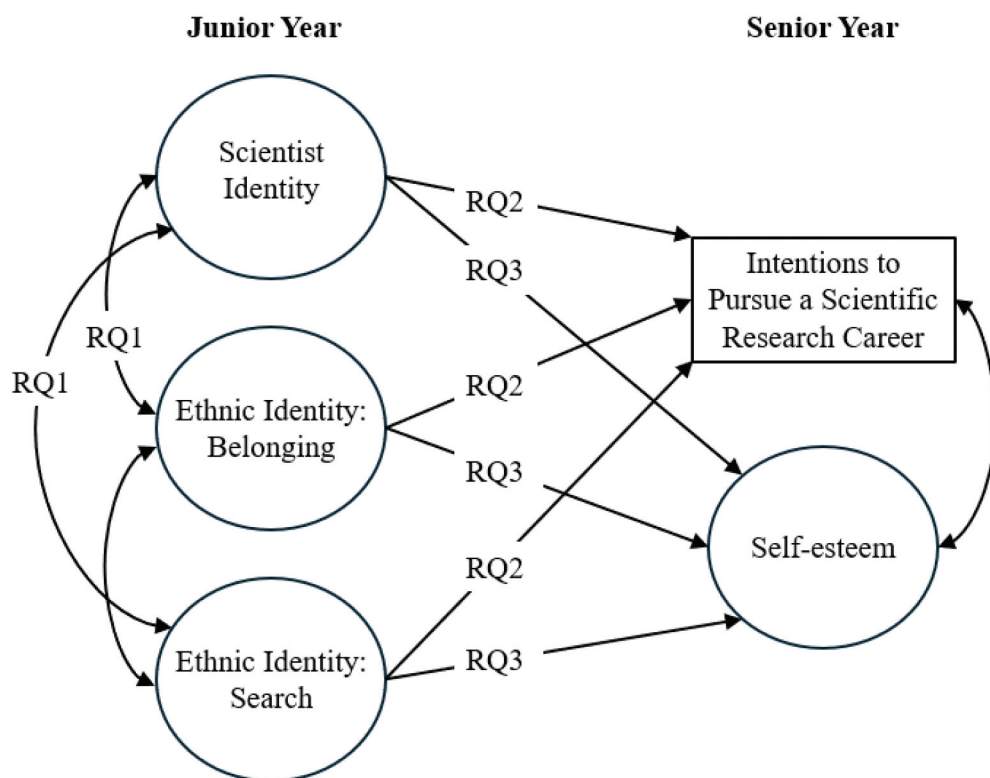


Figure 1. Our conceptual model (research questions 1–4). Circles represent latent variables, and rectangles represent observed variables. RQ1 = Research Question 1 (How do students’ scientist and ethnic identity relate to one another?); RQ2 = Research Question 2 (How do students’ scientist and ethnic identity relate to their intentions to pursue a scientific research career?); RQ3 = Research Question 3 (How do students’ scientist and ethnic identity relate to their self-esteem?).

and each facet of ethnic identity during junior year while controlling for intentions to pursue a scientific research career and self-esteem during junior year. By controlling for each measure in the prior year, in which we used observed (vs. latent) variables for these covariates to reduce model complexity, significant correlations denoted that the predictor was associated with a *change* in the outcome across time.

To examine RQ4 (Are any of our correlations influenced by ethnicity, gender, or MSTP enrollment?), we used separate nested model comparisons for each RQ and sociodemographic factor to compare a model in which all paths specific to the RQ being examined (see Figure 1) were freely estimated to a model in which these paths were constrained to be equal across the sociodemographic factor being examined. Using the $\Delta\chi$ test, a significant $\Delta\chi$ indicated at least one of the paths for that RQ differed across the sociodemographic factor being examined (Cheung & Rensvold, 2002; Hirschfeld & von Brachel, 2014). To identify which path(s) was/were significantly different, we constrained each of the paths relevant to the RQ one at a time across the sociodemographic factor and compared these models to the freely estimated model. If this single constraint resulted in a significant $\Delta\chi$, this path was deemed significantly different across the sociodemographic factor, leading us to examine each within-group correlation.

Table 1. Descriptive statistics and zero-order correlations among the observed study measures.

	Descriptive Statistics				Zero-order Correlations				
	N	M	SD	α	1	2	3	4	5
Junior Year									
(1) Scientist identity	404	3.86	.75	.82	-				
(2) Ethnic identity: belonging	485	3.45	.51	.92	.12*	-			
(3) Ethnic identity: search	492	2.97	.60	.76	.09	.64***	-		
Senior Year									
(4) Intentions to pursue a scientific research career	832	7.43	2.72	-	.44***	.00	.05	-	
(5) Self-esteem	771	3.42	.51	.90	.24***	.29***	.17***	.15***	-

Note. Alpha is not available for intentions to pursue a scientific research career because this was measured with a single item.

* $p < .05$, *** $p < .001$.

Missing data and outliers

Our study variables had varying degrees of missing data (see Table 1). Therefore, we examined whether the missing data were missing completely at random (MCAR; Enders, 2010, 2011) using Little's MCAR test (R. J. A. Little, 1988). Results indicated the data were not missing completely at random ($p < .001$; i.e., the data were systematically missing). Following the procedures of Estrada and colleagues (Estrada, Hernandez, et al., 2018) (who restructured *TheScienceStudy* data as we have here), we identified background/demographic characteristics and academic motivation variables associated with the missing data at enrollment into *TheScienceStudy*. Eight variables were uniquely associated with the missing data: year in school at the time of enrollment, year of recruitment (wave 2 and wave 3), living situation (living with family, living by themselves, living with a roommate, living with a partner and no child), and ethnicity. All models included these variables as auxiliary variables to control for missing data bias (Collins et al., 2001).⁶

No outliers were detected based on studentized deleted residuals and Cook's D (Judd et al., 2009).

Results

Table 1 reports descriptive statistics for the observed measures across the full sample and their zero-order correlations. Table 2 reports descriptive statistics for the observed measures across each sociodemographic factor. Figure 2 reports the results of our structural equation model that was used to examine research questions 1, 2, and 3. We report these results in detail below, and references to effect sizes are based on Funder and Ozer (2019): small ($r/\beta = .10-.19$), medium ($r/\beta = .20-.29$), large ($r/\beta = .30-.39$).

RQ1: How Do Students' Scientist and Ethnic Identity Relate to One Another?

To examine how students' scientist identity related to their ethnic identity, we examined the covariation between these identities during students' junior year. As indicated in Figure 2, students' scientist identity had a small and positive correlation with the search facet of ethnic identity ($p = .008$) as well as the belonging facet of ethnic identity ($p = .014$). This indicated that students' scientist and ethnic identities were positively related to one another during their junior year.

Table 2. Descriptive statistics among the observed study measures across each sociodemographic factor.

	Junior Year						Senior Year					
	Scientist identity			Ethnic identity: belonging			Ethnic identity: search			Intentions to pursue a scientific research career		
	N	M (SD)	α	N	M (SD)	α	N	M (SD)	α	N	M (SD)	α
Ethnicity												
African American	227	3.78 (.74)	.82	260	3.49 (.47)	.90	264	3.10 (.56)	.77	442	7.23 (2.69)	
Hispanic	177	3.95 (.74)	.82	225	3.39 (.55)	.94	228	2.83 (.61)	.75	390	7.65 (2.73)	
Gender												
Woman	294	3.82 (.76)	.82	362	3.47 (.49)	.91	367	2.99 (.61)	.78	620	7.39 (2.69)	
Man	110	3.95 (.72)	.83	123	3.37 (.57)	.93	125	2.94 (.57)	.71	212	7.52 (2.79)	
MSTP Enrollment												
Yes	209	3.94 (.74)	.85	245	3.51 (.49)	.92	250	3.07 (.56)	.75	420	7.92 (2.55)	
No	195	3.76 (.74)	.80	240	3.38 (.52)	.92	242	2.88 (.62)	.77	412	6.92 (2.79)	

Note. MSTP = minority science training program; α is not available for intentions to pursue a scientific research career because this was measured with a single item.

RQ2: How Do Students' Scientist and Ethnic Identity Relate to Their Intentions to Pursue a Scientific Research Career?

To examine how students' scientist and ethnic identities related to their intentions to pursue a scientific research career, we examined how each identity during students' junior year predicted their intentions to pursue a scientific research career during students' senior year. As indicated in Figure 2, students' scientist identity ($p < .001$), but not ethnic identity (belonging: $p = .649$; search: $p = .753$), had a medium and positive correlation with their intentions to pursue a scientific research career. This indicated that students' scientist, but not ethnic, identity during their junior year related to increased intentions to pursue a scientific research career during their senior year.

RQ3: How Do Students' Scientist and Ethnic Identity Relate to Their Self-esteem?

To examine how students' scientist and ethnic identities related to their self-esteem, we examined how each identity during students' junior year predicted students' self-esteem during senior year. As indicated in Figure 2, students' scientist identity ($p = .064$) and ethnic identity (belonging: $p = .893$; search: $p = .205$) were not correlated with their self-esteem. This indicated that neither students' scientist nor ethnic identity during their junior year related to their self-esteem during their senior year.

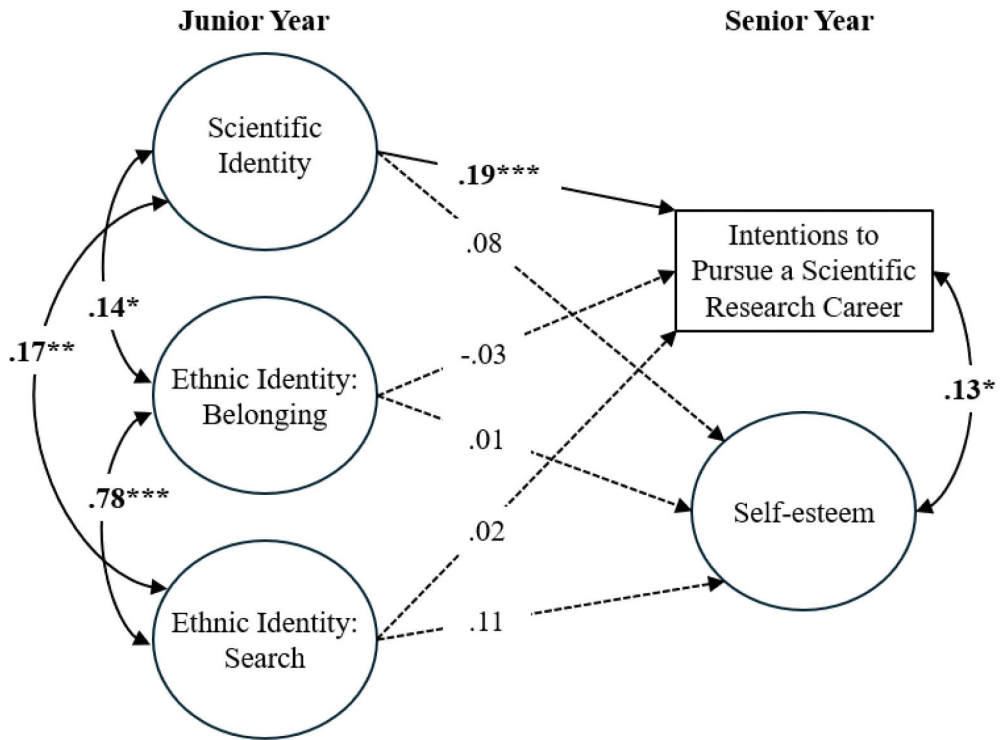


Figure 2. Path correlations for our conceptual Model (research questions 1–3). Circles represent latent variables, and rectangles represent observed variables. Dashed lines indicate correlations that were not significant, and solid lines indicate significant correlations. Reported parameter estimates refer to standardized regression betas (β). * $p < .05$, ** $p < .01$, *** $p < .001$

RQ4: Are Any of Our Correlations Influenced by Ethnicity, Gender, or MSTP Enrollment?

Using a series of $\Delta\chi^2$ tests in which we compared unconstrained models to models in which relevant paths were constrained to be equal across levels of the sociodemographic factor being examined, we next examined whether any of the results for research questions 1, 2, and 3 reported above were influenced by students' ethnicity, gender, or enrollment status in a MSTP. As indicated in Table 3, the $\Delta\chi^2$ for RQ1–RQ3 (see Figure 1 for the relevant paths) across ethnicity (African American vs. Hispanic) and gender (woman vs. man) were not significant. This indicated that our research question correlations were not influenced by ethnicity or gender. However, although the $\Delta\chi^2$ for RQ1 in terms of MSTP enrollment was not significant, the $\Delta\chi^2$ for RQ2 and RQ3 was significant (Table 3). Specifically, students' enrollment status in a MSTP influenced the relationship between students' scientist and ethnic identities and their intentions to pursue a scientific research career (RQ2) and self-esteem (RQ3), but not the relationship between their scientist and ethnic identities (RQ1). We conducted follow-up $\Delta\chi^2$ to examine how students' enrollment status in a MSTP influenced the nature of these relationships.

In terms of the relationship between students' junior-year scientist and ethnic identities and their senior-year intentions to pursue a scientific research career (RQ2), follow-

up $\Delta\chi^2$ tests indicated the relationship between each facet of students' ethnic identity (belonging: $\Delta\chi^2 = 10.28$, $p = .001$; search: $\Delta\chi^2 = 4.95$, $p = .026$), but not scientist identity ($\Delta\chi^2 = .71$, $p = .399$), and their intentions to pursue a scientific research career was influenced by MSTP enrollment. Specifically, as indicated in Figure 3, whereas the belonging facet of ethnic identity during junior year had a large and *negative* correlation with intentions to pursue a scientific research career during senior year among students enrolled in a MSTP ($\beta = -.34$, $p = .010$), the correlation was small and *positive* among students not enrolled in a MSTP ($\beta = .17$, $p = .077$). Additionally, as indicated in Figure 3, whereas the search facet of ethnic identity during junior year had a medium and *positive* correlation with intentions to pursue a scientific research career during senior year among students enrolled in a MSTP ($\beta = .25$, $p = .067$), the correlation was small and *negative* among students not enrolled in a MSTP ($\beta = -.12$, $p = .256$). However, these latter two within-group correlations particularly need to be interpreted with caution because although the $\Delta\chi^2$ test denoted that these correlations were significantly different from one another, neither within-group correlation was significant.

In terms of the relationship between students' junior-year scientist and ethnic identities and their senior-year self-esteem (RQ3), follow-up $\Delta\chi^2$ tests indicated that the correlation between students' scientist identity ($\Delta\chi^2 = 8.55$, $p = .003$), but not ethnic identity (belonging: $\Delta\chi^2 = .04$, $p = .834$; search: $\Delta\chi^2 = .00$, $p = .948$), and their self-esteem was also influenced by MSTP enrollment. Specifically, as indicated in Figure 3, scientist identity during junior year had a medium and positive correlation with self-esteem during senior year among students enrolled in a MSTP ($\beta = .21$, $p = .001$). However, the correlation between scientist identity and self-esteem was not significant among students not enrolled in a MSTP ($\beta = -.05$, $p = .446$).

Table 3 Results of the Nested Model Comparisons Examining Whether Our Research Question Correlations were Influenced by the Sociodemographic Factors of Ethnicity, Gender, and Minority Science Training Program Enrollment (Research Question 4)

Sociodemographic Factor	$\Delta\chi^2$ (df)	p
Ethnicity (African American vs. Hispanic)		
RQ1: Scientist identity ↔ ethnic identity	2.39 (2)	.303
RQ2: Scientist/ethnic identity → scientific career intentions	3.66 (3)	.301
RQ3: Scientist/ethnic identity → self-esteem	6.00 (3)	.112
Gender (Woman vs. Man)		
RQ1: Scientist identity ↔ ethnic identity	1.80 (2)	.406
RQ2: Scientist/ethnic identity → scientific career intentions	4.51 (3)	.212
RQ3: Scientist/ethnic identity → self-esteem	4.14 (3)	.247
Minority Science Training Program Enrollment (No vs. Yes)		
RQ1: Scientist identity ↔ ethnic identity	3.80 (2)	.150
RQ2: Scientist/ethnic identity → scientific career intentions	11.72 (3)	.008**
RQ3: Scientist/ethnic identity → self-esteem	8.85 (3)	.031*

Note. The $\Delta\chi^2$ tests compared a model in which all paths specific to the research question being examined (see Figure 1) were freely estimated to a model in which these paths were constrained to be equal across the sociodemographic factor being examined. RQ1 = Research Question 1 (How do students' scientist and ethnic identity relate to one another?); RQ2 = Research Question 2 (How do students' scientist and ethnic identity relate to their intentions to pursue a scientific research career?); RQ3 = Research Question 3 (How do students' scientist and ethnic identity relate to their self-esteem?); → = regression path; ↔ = covariation.

* $p < .05$, ** $p < .01$

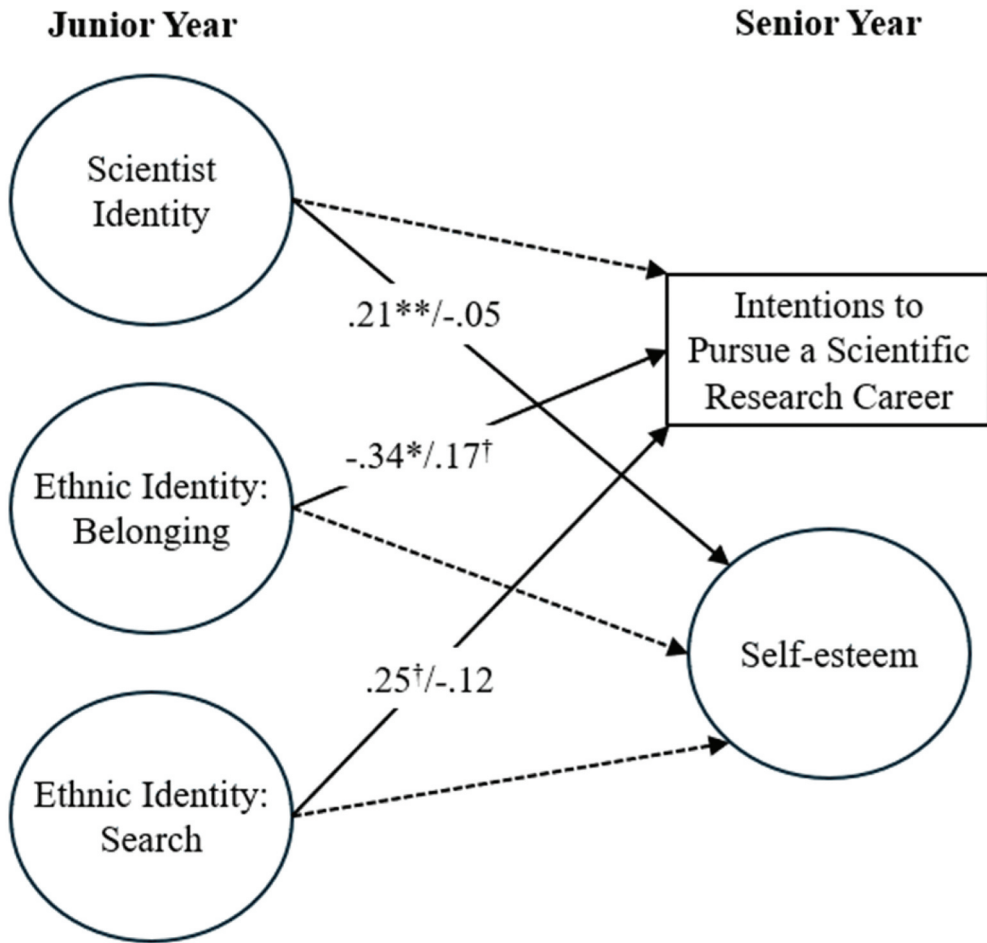


Figure 3. Path correlations that were influenced by minority science training program enrollment (enrolled in a MSTP β /not enrolled in a MSTP β). Circles represent latent variables and rectangles represent observed variables. Dashed lines indicate paths that were not influenced by minority science training program enrollment and solid lines indicate paths that were influenced by minority science training program enrollment. Reported parameter estimates refer to standardized regression betas (β). MSTP = minority science training program. $^{\dagger}p < .078$, $*p < .05$, $**p < .01$

Discussion

Increasing the representation of African American and Hispanic people in scientific research careers is a national priority (Hong & Page, 2004; National Center for Science and Engineering Statistics, 2023; Olson & Riordan, 2012; Valentine & Collins, 2015). To better understand the factors that could inform how to address this priority, this longitudinal and preregistered study examined how the scientist *and* ethnic identities among a large sample of African American and Hispanic undergraduate STEM students ($N = 1,247$) related to one another, their intentions to pursue a scientific research career, self-esteem, and whether sociodemographic factors influenced these relationships.

Relationship between scientist and ethnic identities

STEM students who behave like a scientist are generally rewarded by academic and scientific community members with praise, good grades, and/or additional research opportunities. These rewards, in turn, foster students' scientist identity (Estrada, Young, et al., 2019; Kelman, 2006). However, because the ethnic groups of African American and Hispanic STEM students have historically been underrepresented and negatively stereotyped by others, their ethnic identity could relate to their scientist identity in important ways. Although the direction of the relationship was unclear based on past research, we observed small and positive correlations between scientist identity and both facets of ethnic identity. Thus, just like White women enrolled in STEM programs who report small and positive correlations between their scientist and woman identities (women are historically underrepresented and negatively stereotyped in STEM fields as well) (Settles, 2004; Settles et al., 2009), our results suggest that African American and Hispanic STEM students can also find ways for their scientist identity to complement their historically underrepresented and negatively stereotyped ethnic identity. Although the direct relationship between how strongly students identify with these two identities might be positive among these historically underrepresented students (and not influenced by ethnicity, gender, or MSTP enrollment), Amiot and colleague's (2007) Model of Social Identity Development and Integration suggests that factors such as social support and effective coping skills might strengthen their relationship whereas identity threats might weaken their relationship.

Scientist and ethnic identities and scientific research career intentions

Because professional scientists generally conduct scientific research, replicating the positive correlation between the scientist identity of African American and Hispanic STEM students and their intentions to pursue a scientific research career was not surprising (Chemers et al., 2011; Estrada et al., 2011; Woodcock et al., 2012). However, the nature of the relationship between their ethnic identity and intentions to pursue a scientific research career was unclear based on past research. Interestingly, our results indicated that students' ethnic identity was unrelated to their intentions to pursue a scientific research career. Although they did not directly relate, certain factors could influence the relationship. Indeed, although not influenced by gender or ethnicity, the relationship was influenced by MSTP enrollment. Specifically, for students enrolled in a MSTP, a sense of belonging with their ethnic group was related to *decreases* in their intentions to pursue a scientific research career; however, it was related to *increases* for those not enrolled. This interesting pattern could suggest that MSTPs overemphasize scientific training and identities, leaving students uncertain about whether they can belong to their ethnic group *and* pursue a scientific career. Although one MSTP mentions the need to "acknowledge the value of students from all backgrounds in the academy" (Matsui, 2018, p. 2), whether students are explicitly taught to recognize the value of being a part of their ethnic group while enrolled in MSTPs has not been empirically examined.

Though the correlations were not significant despite being small to medium in size (i.e., interpret with caution), searching and exploring the personal meaning of one's ethnic

group had an opposite pattern: related to *increases* in intentions to pursue a scientific research career among those enrolled in a MSTP, but related to *decreases* among those not enrolled. According to Erikson's (1968) ego identity model, searching and exploring are critical precursors to being secure in one's identity and having a secure ethnic identity is especially important for ethnic minority people (Phinney, 1990; Umaña-Taylor, 2011). Thus, even if MSTPs create uncertainty about belonging to one's ethnic group and pursuing a scientific research career, those who have searched and explored the meaning of their ethnic identity (i.e., those likely to have a more secure and stronger ethnic identity) might already understand its value and use it as motivation against the backdrop of the support the MSTPs provide. However, for students who have searched and explored the meaning of their ethnic identity but don't have the support of MSTPs, frequently not being recognized as a scientist and/or coping with ethnic-related threats (Carlone & Johnson, 2007; McGee, 2016) might lead them to protect their ethnic identity by opting not to pursue a STEM career (Cohen & Garcia, 2008; Steele, 1997). In addition to enrollment in MSTPs influencing the relationship between different facets of ethnic identity and intentions to pursue a scientific research career, a review by Destin and Williams (2020) on the factors that influence the relationship between ethnic identity and academic persistence and motivation point to various other factors that could play an important role (e.g., the culture of the academic environment or perceptions of negative stereotypes).

Scientist and ethnic identities and self-esteem

Many theories indicate that social identities directly impact self-esteem (Martiny & Rubin, 2016; Tajfel & Turner, 1979). Because self-esteem is a crucial aspect of mental health (Fusar-Poli et al., 2020) and can influence decisions to pursue scientific research careers (Nature Editorial, 2020; Wilkins-Yel et al., 2022), it is important to understand how the scientist and ethnic identities of African American and Hispanic STEM students relate to their self-esteem. Our results indicated that both identities had small and positive correlations with self-esteem across time (see Table 1), but neither were related to *changes* in self-esteem across time (i.e., controlling for prior year self-esteem; see Figure 2). Although it was surprising that neither students' scientist nor ethnic identity related to changes in their self-esteem across time, the results of Settles and colleagues (2009) may provide insights into why. Specifically, among White women in STEM fields (who have also historically been underrepresented and negatively stereotyped), neither their scientist nor woman identities related to changes in their self-esteem across time. However, although the effects were small, they also found that, in terms of Pearson *r* correlations, *increases* in their scientist *and* woman identities were related to *increases* in their self-esteem across time. Further, the extent to which these identities interfered with one another (e.g., "I feel that other scientists do not take me seriously because I am a woman," "It is hard to be a woman and a scientist in my field at the same time") related to *decreases* in their self-esteem across time. In other words, *changes* in self-esteem among STEM students who are historically underrepresented and negatively stereotyped might be specifically related to *changes* in students' scientist and other important identities as well as the extent that their identities are perceived as interfering with one another. Indeed, when we examined Pearson *r* correlations between changes in self-esteem and

changes in scientist and ethnic identity between junior and senior year using change scores [consistent with Settles and colleagues (2009)], we found that *changes* in the belonging facet of ethnic identity was positively correlated (.24) with *changes* in self-esteem. However, changes in scientist identity as well as the search facet of ethnic identity were not significantly correlated with changes in self-esteem. Interestingly, an item we included during junior year that stated “Thinking of myself as a scientist is compatible with other aspects of my background (ethnicity, gender, social class, etc.),” which might be conservative proxy for the identify-interference measure used by Settles and colleagues (2009), was not related to changes in self-esteem. Still, though women identities are negatively stereotyped in STEM fields and, therefore, can provide some level of comparison to a negatively stereotyped ethnic identity, there are numerous important differences between a White woman and their woman identity and a person with an African American or Hispanic ethnic identity. For example, because White women still have a White identity that could buffer any stereotypes they face against their woman identity, African Americans and Hispanic people do not always have a core identity that is safe from negative stereotypes.

Though gender, ethnicity, nor MSTP enrollment influenced the relationship between ethnic identity and self-esteem, we did find that MSTP enrollment, but not gender or ethnicity, influenced the relationship between scientist identity and self-esteem. Specifically, scientist identity was related to increases in self-esteem for those enrolled in a MSTP, but they were not related to one another among those not enrolled. If MSTPs do overemphasize scientific training and identities as we suggested above, these results could suggest that changes in self-esteem across time might become particularly coupled with scientist identity for students in these programs.

Implications

Our results suggest that the scientist *and* ethnic identity of African American and Hispanic STEM students have important implications for one another and factors related to whether students pursue scientific research careers. Future research, therefore, should advance our understanding of the factors that can undermine as well as foster these identities. There is accumulating theoretical and empirical evidence that perceiving negative stereotypes can undermine students’ scientist and ethnic identities (Carlone & Johnson, 2007; Cohen & Garcia, 2008; Malone & Barabino, 2009; McGee, 2016), particularly at colleges not historically comprised of ethnically similar people (Woodcock et al., 2012). Because it is unacceptable that an African American, Hispanic, or any student must contend with people negatively stereotyping them, we need to find ways to disrupt the holding of negative stereotypes by others. One way to accomplish this could involve educating people in STEM departments about the benefits of ethnic and cultural diversity. Such training could help people in STEM departments view African American and Hispanic students, and the adversities many have overcome, as assets that make them uniquely qualified scientists (Estrada et al., 2016; McGee, 2016). These perceptual shifts could foster more inclusive environments in which diverse identities are affirmed more frequently and ultimately lead to increases in student retention (Estrada, Young, et al., 2019). The elimination of these negative stereotypes might also lead to stronger positive

relationships between their various identities and their intentions to pursue scientific research careers and well-being (Cohen & Garcia, 2008; Destin & Williams, 2020).

Our results also suggest MSTPs have crucial implications for how students' scientist identity and different facets of their ethnic identity relate to their intentions to pursue scientific research careers and well-being. While these well-intentioned programs are often successful in helping minority students complete their degrees (e.g., Matsui, 2018), our results suggest they might undermine scientific research career intentions among those who feel a sense of belonging with their ethnic group. This means these programs must ensure they are acknowledging and affirming the multiple salient identities that minority students have so that each of their identities positively contribute to their motivations to stay in STEM fields and self-esteem. This is especially important because self-esteem might have its own implications for whether students pursue scientific research career (Nature Editorial, 2020; Wilkins-Yel et al., 2022). Indeed, we observed a small and positive correlation between students' intentions to pursue a scientific research career and self-esteem (see Figure 2).

Limitations and future directions

Our study had several limitations. First, many of our students being enrolled at colleges comprised of ethnically similar people may limit the generalizability of our results to African American and Hispanic STEM students who are enrolled at universities predominantly comprised of White and/or Asian students. For example, both historically black colleges (76% of our African American students; Allen et al., 2007) and Hispanic-serving institutions (53% of our Hispanic students; Laden, 2004) provide historically underrepresented ethnic students with more opportunities to interact with ethnically similar peers and faculty (especially at historically black colleges). These enhanced opportunities could create environments that are, overall, less threatening to their social identities (e.g., Woodcock et al., 2012). Future studies should attempt to replicate our results using samples of African American and Hispanic STEM students who are enrolled at colleges that are predominantly White or Asian. Second, although students' scientist and ethnic identities were positively and contemporaneously correlated with one another, longitudinal associations could reveal a different pattern (e.g., Settles et al., 2009). Understanding their contemporaneous *and* longitudinal associations will help us better understand when and whether these identities can complement one another and how their interplay shapes decisions to pursue scientific research careers and well-being. Amiot and colleague's (2007) model of Social Identity Development and Integration could serve as a useful framework to examine this. Third, based on past research (Nature Editorial, 2020; Wilkins-Yel et al., 2022), we suggested that students' scientist and ethnic identities might indirectly relate to their intentions to pursue a scientific research career through self-esteem. Although self-esteem had a small and positive contemporaneous association with students' intentions during senior year (see Figure 2), only longitudinal associations can provide empirical support for our suggestion. Fourth, and related to the prior limitation noted, we examined the compatibility (vs. interference) of students' scientist and ethnic identities by examining how they related to one another. However, past studies such as those examining the construct of Bicultural Identity Integration (Benet-

Martínez & Haritatos, 2005) have used measures directly asking about the extent to which different identities were perceived as being compatible or interfering with one another. This means that it is unclear whether a positive correlation between students' scientist and ethnic identity is equivalent to students directly reporting that these identities are compatible with one another. Finally, although our study provided several novel insights, enrollment into *TheScienceStudy* began 19 years ago as of 2024. Because the nature and prevalence of negative ethnic stereotypes as well as the overall culture of STEM fields could have significantly changed over this period, replicating our results using more recent data is an important next step.

Final thoughts

The increased representation of African American and Hispanic people in STEM careers over the last decade is exciting. However, far too many African American and Hispanic STEM students continue to have experiences that discourage them from completing their degree and pursuing a scientific research career. We, therefore, hope research in this area continues to inform our understanding of why students do and do not pursue scientific research careers as well as how we can build inclusive STEM environments that foster the identities, mental health and well-being, and success of all students. By doing this, the next generation of African American and Hispanic people might see more people like them in scientific research careers and be inspired to be like them.

Notes

1. The study design as well as all analyses reported in this manuscript were pre-registered prior to conducting this study. Our preregistration can be found at <https://osf.io/hy9up>
2. We preregistered also examining how students' perceptions of negative ethnic stereotypes during their sophomore year related to their scientist and ethnic identities during junior year. We decided to remove perceptions of negative ethnic stereotypes from this manuscript for two reasons. First, the sample size ($N = 245$) and the sociodemographic factor cell sizes for perceptions of negative stereotypes were relatively small (e.g., Men $n = 58$) compared to the other model variables (see Tables S2 and S3 in Appendix A of the online supplementary materials). This resulted in being underpowered, particularly for our moderation analyses. Second, the results for the remaining model paths were the same regardless of whether we included perceptions of negative ethnic stereotypes in the model. Although perceptions of negative ethnic stereotypes did not relate to either scientist or ethnic identity, we report the results of each research question for the full preregistered model in Appendix A of the online supplemental materials.
3. Woodcock and colleagues (2012) used a subset of our participants to also examine longitudinal correlations between scientist identity and intentions to pursue a scientific research career. However, our study also examined ethnic identity and self-esteem. The inclusion of these variables enabled us to extend their findings by examining an additional identity that might relate to multiple outcomes with implications for scientific research career decisions (intentions and self-esteem). Because the samples were not exactly the same and our additional variables created a different variance-covariance model matrix, our overlapping variable associations with Woodcock and colleagues (2012) could be different. Additionally, while Woodcock and colleagues (2012) examined ethnicity and gender as moderators, we examined these and minority science training program enrollment as moderators.

4. Because the item “Thinking of myself as a scientist is compatible with other aspects of my background (ethnicity, gender, social class, etc.)” was administered and relevant to our research questions, we preregistered using confirmatory factor analyses to determine whether to include it as an additional scientist identity item. If model fit was worse with this item, we preregistered using it as an additional predictor of students’ identities during sophomore year. Given that model fit was largely the same with and without this item (with: CFI = .97, RMSEA = .08, SRMR = .03; without: CFI = .97, RMSEA = .09, SRMR = .03), it was not included as a scientist identity item to remain consistent with prior research. It was also not included as a sophomore year predictor since these analyses suggested it could be measuring an aspect of scientist identity.
5. Because model fit was initially low when each of the items across the two facets of ethnic identity as well as self-esteem were used as latent variable indicators, we, via random distribution, used item parcels as indicators to improve reliability and model fit (Little et al., 2002). We preregistered this decision. Specifically, for the belonging facet of ethnic identity, three parcels, in which two parcels comprised two items and one parcel comprised three items, were used as indicators. For the search facet of ethnic identity, three parcels, in which two parcels comprised two items and one parcel comprised the remaining item, were used as indicators. For self-esteem, five parcels, in which each parcel comprised one true-keyed and one false-keyed item, were used as indicators.
6. Because only 10 students recruited during Wave 3 (i.e., a very small cell size) had been enrolled in a minority science training program, the recruitment during Wave 3 auxiliary variable caused model convergence issues when examining our moderation analyses based on enrollment in a minority science training program. We, therefore, did not include this variable as an auxiliary variable in these specific analyses.

Disclosure statement

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