

Understanding the Relationships Between the Racial Identity, Science Identity, and Science Self-Efficacy Beliefs of African American Students at HBCUs

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Problem

Traditionally, science and science-related careers were designated as privileges for White elite, specifically White males (Russell & Atwater, 2005). African Americans are considered underrepresented in science because the percentage of African Americans with science degrees and working in science-related careers is dramatically lower than the percentage of African Americans in the U.S. population; however, whites and Asians are overrepresented (NSF, 2013; Fries-Britt, S., Younger, T., Hall, W. 2010). Today, the majority of African American college students are enrolled in predominantly White institutions (PWIs) (Fries-Britt & Turner, 2001); however, historically Black colleges and universities (HBCUs) produce a disproportionately high number of minority graduates in science, technology, engineering, and mathematics (STEM) (Shorette & Palmer, 2015). The disparity between the number of African American STEM graduates from HBCUs and PWIs is a sign that there is a problem at the institutional level as it relates to educating African American students in science.

Theoretical Framework

The theoretical framework utilized in this study synthesizes four isolated theoretical constructs into one comprehensible framework. The substantive theories of this framework include *social cognitive theory* (Bandura 1977a, 1977b, 1986), *situated-mediated identity theory* (Murrell, 2007, 2009), *science identity* (Carlone & Johnson, 2007) and *Multidimensional Model of Racial Identity* (Sellers, Smith, Shelton, Rowley, & Chavous, 1998). In addition to the aforementioned substantive content theories, this study has been informed by the central tenets of my inquiry worldview of Critical Race Theory.

Table 1. CRT Tenets: Descriptions from various sources

CRT Tenet	Description
Permanence of racism	The notion that racism is a normal part of American society – racism is ordinary, not aberrational
Challenge Dominant Ideology	Criticizes or challenges claims of meritocracy in society, the colorblind paradigm, incremental change, and neutrality law
Voices of people of color (Centrality of Experiential Knowledge)	The lived racialized experiences of people of color are captured through counter storytelling and counter-narrative; aims to cast doubt on the validity of widely accepted myths/messages (in particular those held by the majority)
Structural determinism	Widely shared practice dictates significant social outcomes; Due to the structure of certain systems some problems will not be resolved
Interest convergence or material determinism	The interests of people of color will only be granted when they converge with the interests of Whites – mutually beneficial
Intersectionality	Explores the intersecting roles of race, sexuality, gender, class

Research Questions and Hypotheses

Research Questions & Hypotheses

- What is the relationship between the science self-efficacy beliefs, science identity, and racial identity of African American students attending HBCUs?
H₂: As the racial identity of African American students attending an HBCU increases, their science identity will increase.
- To what extent does science identity, science self-efficacy, and racial identity influence the science achievement of African American students attending HBCUs?
H₃: As the science self-efficacy beliefs of African American students attending an HBCU increase, their science identity will increase.
- To what extent do the pre-college experiences of African American students attending HBCUs influence their science self-efficacy beliefs, science identity, racial identity, and college science achievement?
H₂: There is a positive correlation between the pre-college experiences of African American students attending HBCUs and their science self-efficacy beliefs.
- What is the role of the HBCU context in supporting/affirming/facilitating the development of racial identity, science identity and science self-efficacy beliefs, as well as the positive integration of racial and science identities?

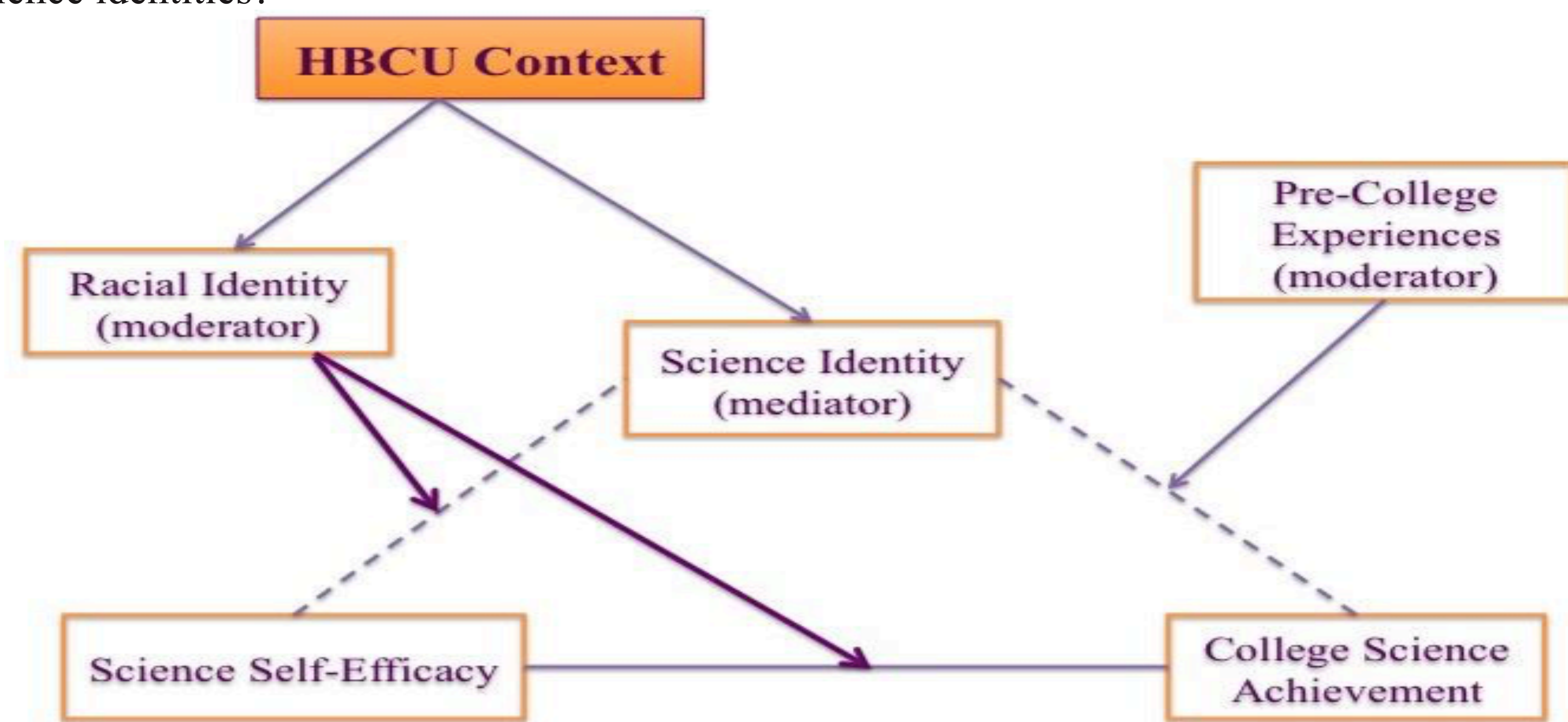


Figure 1. Hypothesized relationships between racial identity, science identity, science self-efficacy beliefs, science achievement, pre-college experiences, and college context of African American students at HBCUs.

Methods

Concurrent Nested Mixed Methods Design (QUANT + qual)

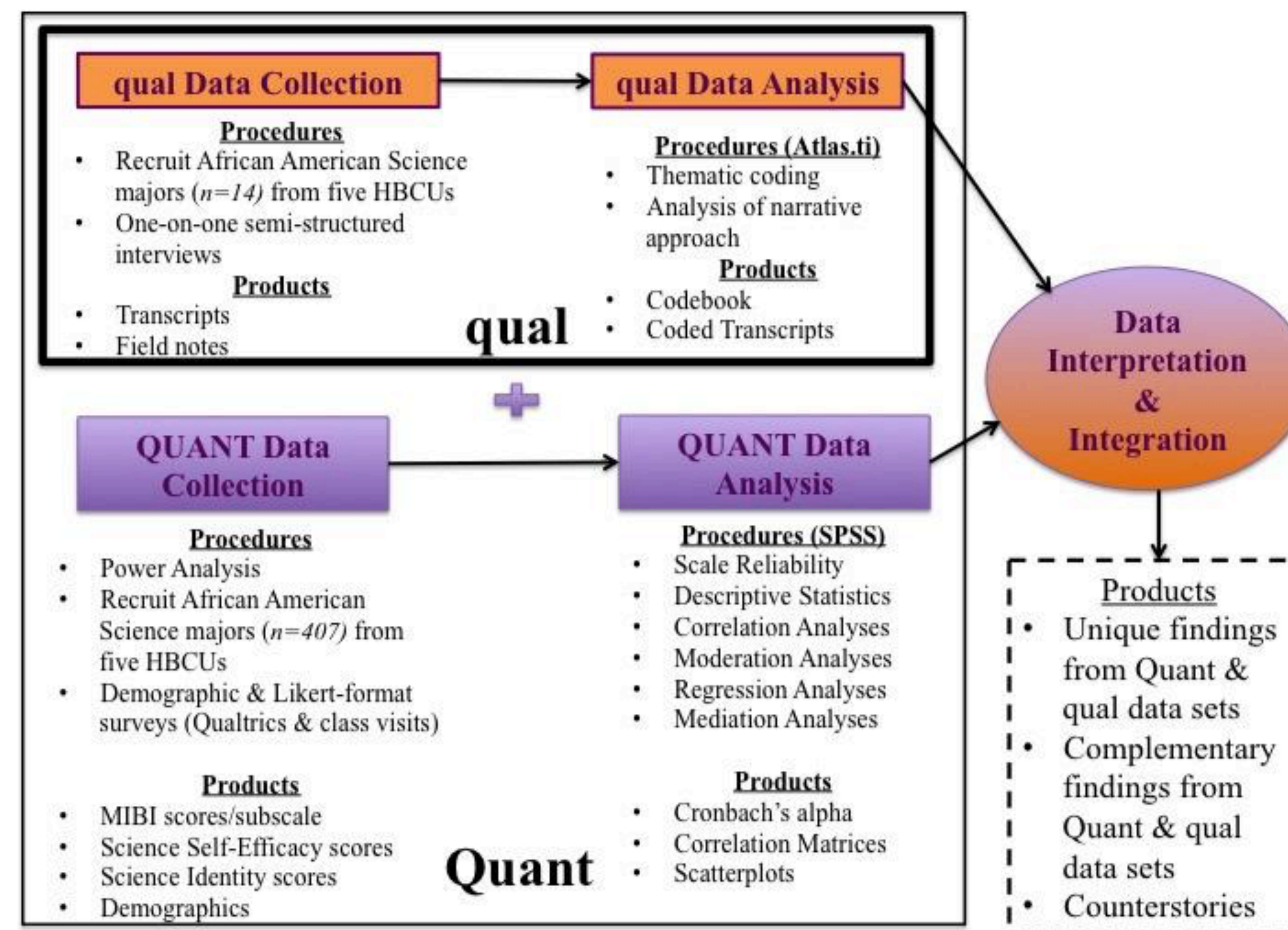


Figure 2. Concurrent Nested Mixed Methods Design based on Creswell & Plano-Clark, 2011

Quantitative Results

Research Questions 1 & 2

Table 2

Pearson Correlation Matrix among Science Identity, Centrality, Assimilation, Nationalist, and Public Regard

Variable	1	2	3	4	5
1. Science Identity	-				
2. Centrality	0.09	-			
3. Assimilation	0.20	-0.01	-		
4. Nationalist	0.01	0.54	-0.03	-	
5. Public Regard	0.03	-0.29	0.22	-0.15	-

Note. The critical values are 0.12, 0.16, and 0.20 for significance levels .05, .01, and .001 respectively.

Table 3

Pearson Correlation Matrix among Science self-efficacy, Centrality, Assimilation, Nationalist, and Public Regard

Variable	1	2	3	4	5
1. Science self-efficacy	-				
2. Centrality	-0.11	-			
3. Assimilation	-0.06	-0.02	-		
4. Nationalist	0.05	0.53	-0.04	-	
5. Public Regard	0.11	-0.27	0.20	-0.12	-

Note. The critical values are 0.12, 0.16, and 0.20 for significance levels .05, .01, and .001 respectively.

Table 4

Moderation Analysis Table with Science self-efficacy Predicted by Science Identity Moderated by Centrality

Variable	B	SE	t	p	β
Step 1: Simple Effects Model (Intercept)					
Science Identity	3.06	0.17	17.52	< .001	
Centrality	-0.41	0.06	-7.51	< .001	-0.42
Step 2: Non-Interaction Model (Intercept)					
Science Identity	3.25	0.21	15.23	< .001	
Centrality	-0.41	0.06	-7.37	< .001	-0.41
Science Identity: Centrality	-0.04	0.03	-1.55	.122	-0.09
Step 3: Interaction Model (Intercept)					
Science Identity	1.76	0.03	59.42	< .001	
Centrality	-0.40	0.06	-7.23	< .001	-0.40
Science Identity: Centrality	-0.04	0.03	-1.61	.108	-0.09
Science Identity: Centrality	0.05	0.05	1.12	.262	0.06

Note. Causal predictor variable, Science Identity, predicted Science self-efficacy in the simple effects model. The partial F-test, $F(1,266) = 1.26, p = .262$, indicated that the interaction model did not explain significantly more variance than the non-interaction model.

Table 5

Regression Results with Centrality Mediating the Relationship Between College Science GPA and Science self-efficacy

Dependent	Independent	B	SE	t	p
Regression 1: College Science GPA					
Science self-efficacy	Science self-efficacy	-0.07	0.07	-1.00	.319
Regression 2: Centrality					
Science self-efficacy	Science self-efficacy	-0.28	0.13	-2.15	.033
Regression 3: College Science GPA					
Science self-efficacy	Science self-efficacy	-0.08	0.07	-1.17	.243
Centrality	Centrality	-0.05	0.04	-1.30	.195

Note. The results showed that Science self-efficacy was a significant predictor of Centrality

Table 6

Regression Results with Public Regard Mediating the Relationship Between College Science GPA and Science self-efficacy

Dependent	Independent	B	SE	t	p
Regression 1: College Science GPA					
Science self-efficacy	Science self-efficacy	-0.06	0.07	-0.81	.416
Regression 2: Public Regard					
Science self-efficacy	Science self-efficacy	0.26	0.12	2.13	.034
Regression 3: College Science GPA					
Science self-efficacy	Science self-efficacy	-0.06	0.07	-0.88	.378
Public Regard	Public Regard	0.02	0.04	0.57	.570

Note. The results showed that Science self-efficacy was a significant predictor of Public Regard.

Table 7

Research Question 3

Pearson Correlation Matrix among Number of science courses in high school, Number of math courses in high school, High school GPA, number of sciences courses in college, College Science GPA, Science Identity, Science self-efficacy, Centrality, Assimilation, Nationalist, and Public Regard

Variable	1	2	3	4	5	6	7	8	9	10	11
1. No. of science courses in high school	-										
2. No. of math courses in high school	0.29	-									
3. High School GPA	0.15	0.16	-								
4. No. of sciences courses in college	0.09	0.05	0.06	-							
5. College Science GPA	-0.03	-0.02	0.04	0.04	-						
6. Science Identity	0.03	-0.07	-0.14	-0.02	-0.06	-					
7. Science self-efficacy	-0.10	0.04	-0.03	-0.07	-0.03	-0.42	-				
8. Centrality	0.15	-0.04	0.09	0.11	-0.08	0.12	-0.09	-			
9. Assimilation	-0.12	-0.07	-0.13	-0.15	0.02	0.21	-0.01	-0.02	-		
10. Nationalist	0.06	-0.06	-0.09	0.08	-0.10	0.04	0.06	0.55	-0.09	-	
11. Public Regard	-0.10	-0.12	-0.19	-0.25	0.02	0.05	0.11	-0.28	0.19	-0.16	-

Note. The critical values are 0.14, 0.18, and 0.23 for significance levels .05, .01, and .001 respectively.

Qualitative Results through CRT Lens

- Community Cohesion**
 - BLACK RACIAL COHESION
 - STEM COHESION
- Access to the Playing Field**
- Enhancing Perceived Competence & Science Capital through MOTIVATING & DEMANDING Environment**
- My Black is Unique BUT...I strategically assimilate even though I prefer Black spaces**
- I'm not an Imposter BUT a High Achiever**
- Permanence of Racism**
 - "It can be discouraging at times as far as professionals in the field are not welcoming to diversity"
- Challenge Dominant Ideology**
 - "Especially here our department isn't pumping with revenue. So we have to find ways to make things work...You don't necessarily have the same wide variety and extravagant that you have at bigger research funding institutions."
- Intersectionality**
 - "So I feel like me being a woman and an African American, I feel like that's going to play a huge role in how I'm treated"

Figure 4. CRT Results as revealed in participant interviews.

Sample Data Integration

- Data integration through merging and weaving approaches (Fetters, Curry, & Creswell, 2013)
- CONFIRMATION:** Quant findings show a negative correlation between the number of college science courses taken by students and their public regard, which is confirmed by qual interviews.
- EXPANSION:** Quant findings indicate a significant positive correlation between Science Identity and Racial Assimilationist Ideology, while qual findings reveal that students are strongly encouraged by science faculty to participate in conferences, programs, and undergraduate research experiences that require constant interaction with predominantly white researchers/science students. In these cases, African American students are one of few if not the only African American; therefore, interactions with HBCU faculty and peers usually entail conversations or skill development that foster the ability to assimilate. These findings support H₂ for Research Question 1.
- DISCORDANCE:** Quant findings do not provide evidence of a statistically significant relationship between Racial Centrality and Science Identity Science Self-efficacy Beliefs; however, qual findings reveal that the HBCU environment exposes them to a "spectrum of Blackness" and "racial homogeneity" that contribute to how African American students see themselves as scientist as well as their ability to perform science-related tasks.

Discussion

- The structural characteristics of HBCUs (i.e. small class sizes) promote both Black racial and STEM cohesion, thus facilitating stronger racial and science identities
- Strong faculty-student and student-student interactions facilitate development of science identity and science self-efficacy beliefs through vicarious experiences, verbal persuasion, and exposure to African American role models
- African American science students enrolled at five HBCUs have relatively high science identity (M=3.12 – based on 4-point Likert Scale), but relatively low Science Self-efficacy (M=1.77 – Based on 5-point Likert scale).
- Overall, students had a higher score for Assimilationist ideology (M=4.86) than Nationalist ideology (M=4.11).
- Moderation and mediation hypotheses were not supported by the data, findings did reveal significant relationship between the constructs.
- The qualitative findings further reveal that African American students who attend HBCUs prefer "Black Spaces" because they are essential for the construction of their racial identity; however, they strategically assimilate (while maintaining their Black connections) due to the Eurocentric nature of their respective science disciplines.

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