“Disrupting Paradigms and Practices to Diversify the Biology Education Ecosystem”

Angela M. White, Ph.D.
@AngelaW9777
awhite@jcsu.edu

Presentation Objective

The objective of this presentation is to explore the perceptions and experiences of African American/Black women within the science pipeline using a critical perspective to unpack the influence of race and gender on their identity development within science.

The goal is to initiate conversation surrounding the importance of:

- Delineating the experiences of African American/Black women in science distinct from the experiences of women of color.
- Promote the continued investigation of African American/Black women achieving in fields and disciplines like Biology/Science that are perceived to be White male dominated spaces.
- Developing pedagogies and practices that will promote the academic achievement and identity development of African American/Black women in biology/science courses and degree programs.

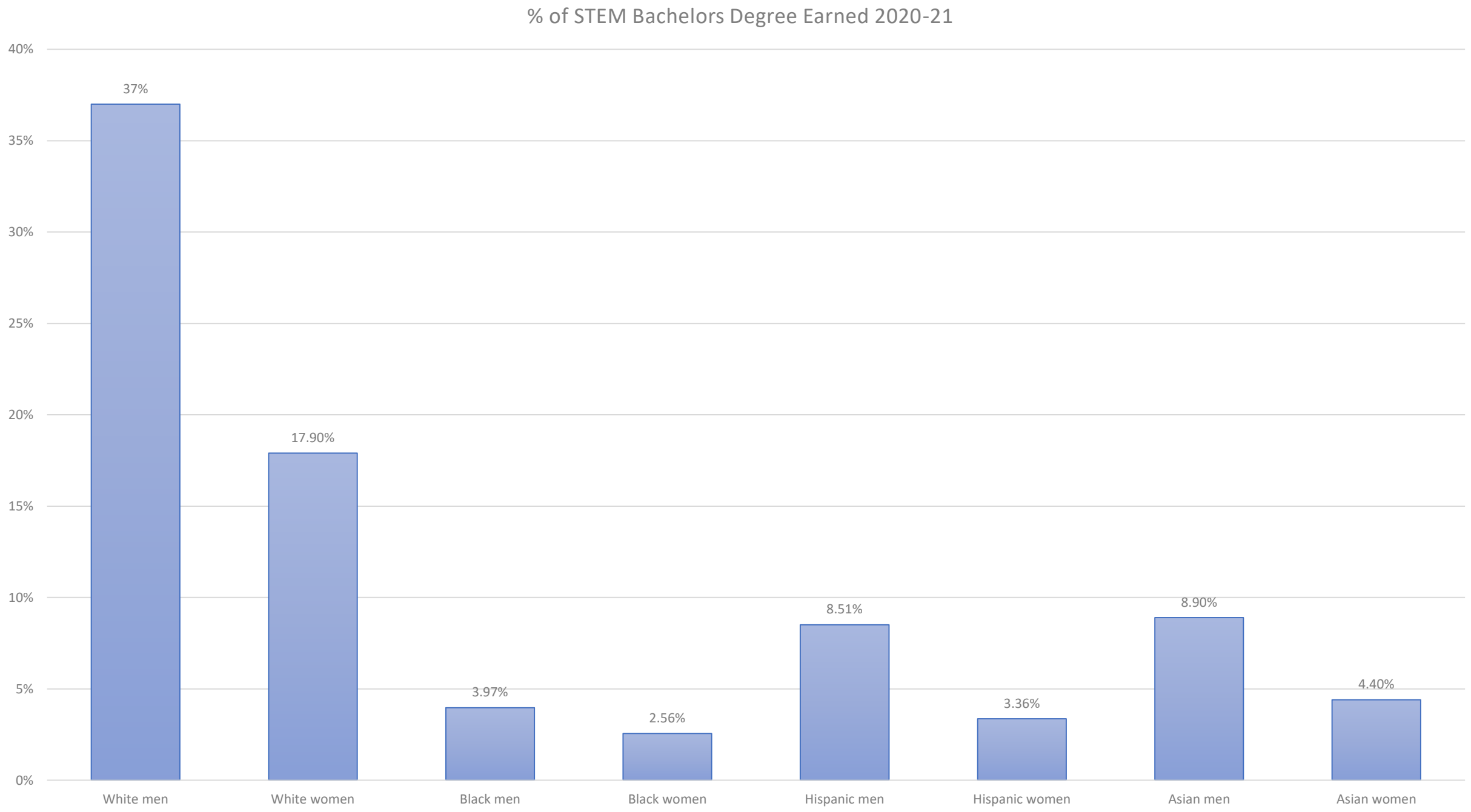

% of STEM Bachelors Degree Earned 2020-21
40%
35%
30%
25%
20%
15%
10%
5%
0%
37%
17.90%
3.97%
2.56%
8.51%
3.36%
8.90%
4.40%
White men
White women
Black men
Black women
Hispanic men
Hispanic women
Asian men
Asian women

Table 322.30. Bachelor's degrees conferred by postsecondary institutions, by race/ethnicity and field of study: Academic years 2019-20 and 2020-21

	2019-20										2020-21									
					Asian/Pacific Islander										Asian/Pacific Islander					
Field of study	Total	White	Black	Hispanic	Total	Asian	Pacific Islander	American Indian/Alaska Native	Two or more races	Nonresident	Total	White	Black	Hispanic	Total	Asian	Pacific Islander	American Indian/Alaska Native	Two or more races	Nonresident
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
All fields, total	**2,038,682**	**1,184,082**	**197,491**	**302,663**	**161,468**	**157,085**	**4,383**	**9,154**	**77,621**	**106,203**	**2,066,445**	**1,172,187**	**206,527**	**324,848**	**169,261**	**164,845**	**4,416**	**9,545**	**81,369**	**102,708**
Agriculture and natural resources[1]	41,858	31,380	1,396	4,449	1,581	1,525	56	269	1,558	1,225	41,925	30,967	1,518	4,749	1,619	1,565	54	268	1,691	1,113
Architecture and related services	9,045	4,823	482	1,506	739	725	14	19	326	1,150	9,296	4,857	532	1,702	835	809	26	25	341	1,004
Area, ethnic, cultural, gender, and group studies	7,771	2,881	1,210	2,012	654	618	36	131	515	368	7,374	2,671	1,163	1,899	617	585	32	149	530	345
Biological and biomedical sciences	126,616	68,867	10,469	18,099	18,853	18,616	237	392	5,591	4,345	131,499	69,108	11,303	20,143	19,935	19,714	221	474	6,142	4,394
Business[2]	387,881	226,523	36,577	53,401	29,078	28,184	894	1,721	12,600	27,981	391,375	224,546	37,983	57,111	30,703	29,745	958	1,852	13,308	25,872

Table 322.50. Bachelor's degrees conferred to females by postsecondary institutions, by race/ethnicity and field of study: Academic years 2019-20 and 2020-21

	2019-20										2020-21									
					Asian/Pacific Islander										Asian/Pacific Islander					
Field of study	Total	White	Black	Hispanic	Total	Asian	Pacific Islander	American Indian/Alaska Native	Two or more races	Nonresident	Total	White	Black	Hispanic	Total	Asian	Pacific Islander	American Indian/Alaska Native	Two or more races	Nonresident
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
All fields, total	**1,177,298**	**675,003**	**127,145**	**185,433**	**88,552**	**86,080**	**2,472**	**5,810**	**46,001**	**49,354**	**1,205,681**	**673,095**	**134,435**	**201,592**	**93,557**	**91,010**	**2,547**	**6,138**	**48,366**	**48,498**
Agriculture and natural resources[1]	23,967	17,382	882	2,828	1,016	976	40	152	999	708	24,516	17,556	960	3,044	1,065	1,035	30	163	1,117	611
Architecture and related services	4,350	2,288	230	666	395	391	4	8	164	599	4,592	2,300	256	787	480	472	8	14	201	554
Area, ethnic, cultural, gender, and group studies	5,699	2,133	868	1,525	476	449	27	88	379	230	5,496	1,994	875	1,469	432	411	21	107	408	211
Biological and biomedical sciences	81,639	43,821	7,610	11,817	11,647	11,491	156	267	3,696	2,781	86,505	45,093	8,283	13,333	12,562	12,431	131	302	4,089	2,843
Business[2]	180,359	98,116	20,580	26,905	14,902	14,451	451	957	6,148	12,751	182,834	97,027	21,671	29,034	15,727	15,230	497	1,035	6,300	12,040

Table 322.40. Bachelor's degrees conferred to males by postsecondary institutions, by race/ethnicity and field of study: Academic years 2019-20 and 2020-21

	2019-20										2020-21									
					Asian/Pacific Islander										Asian/Pacific Islander					
Field of study	Total	White	Black	Hispanic	Total	Asian	Pacific Islander	American Indian/Alaska Native	Two or more races	Nonresident	Total	White	Black	Hispanic	Total	Asian	Pacific Islander	American Indian/Alaska Native	Two or more races	Nonresident
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
All fields, total	**861,384**	**509,079**	**70,346**	**117,230**	**72,916**	**71,005**	**1,911**	**3,344**	**31,620**	**56,849**	**860,764**	**499,092**	**72,092**	**123,256**	**75,704**	**73,835**	**1,869**	**3,407**	**33,003**	**54,210**
Agriculture and natural resources[1]	17,891	13,998	514	1,621	565	549	16	117	559	517	17,409	13,411	558	1,705	554	530	24	105	574	502
Architecture and related services	4,695	2,535	252	840	344	334	10	11	162	551	4,704	2,557	276	915	355	337	18	11	140	450
Area, ethnic, cultural, gender, and group studies	2,072	748	342	487	178	169	9	43	136	138	1,878	677	288	430	185	174	11	42	122	134
Biological and biomedical sciences	44,977	25,046	2,859	6,282	7,206	7,125	81	125	1,895	1,564	44,994	24,015	3,020	6,810	7,373	7,283	90	172	2,053	1,551
Business[2]	207,522	128,407	15,997	26,496	14,176	13,733	443	764	6,452	15,230	208,541	127,519	16,312	28,077	14,976	14,515	461	817	7,008	13,832

SOURCE: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Fall 2020 and Fall 2021, Completions component. (This table was prepared September 2022.)

STEM Culture and African American/Black Women

- STEM is depicted and perceived as dominated by white or Asian men, competitive, and isolating (McGee et. al, 2017)
- Narrow view of the concepts covered within the realm of STEM disciplines, STEM content and procedural knowledge, and STEM praxes (Morton et al., 2019)
- A space that produces hegemonic norms of how to “perform” as a STEM student (Gholson and Martin, 2019)
- Western, Eurocentric STEM is considered the dominant viewpoint while other ways of knowing and participating are devalued (Roby et al., 2022)

STEM Culture and African American/Black Women

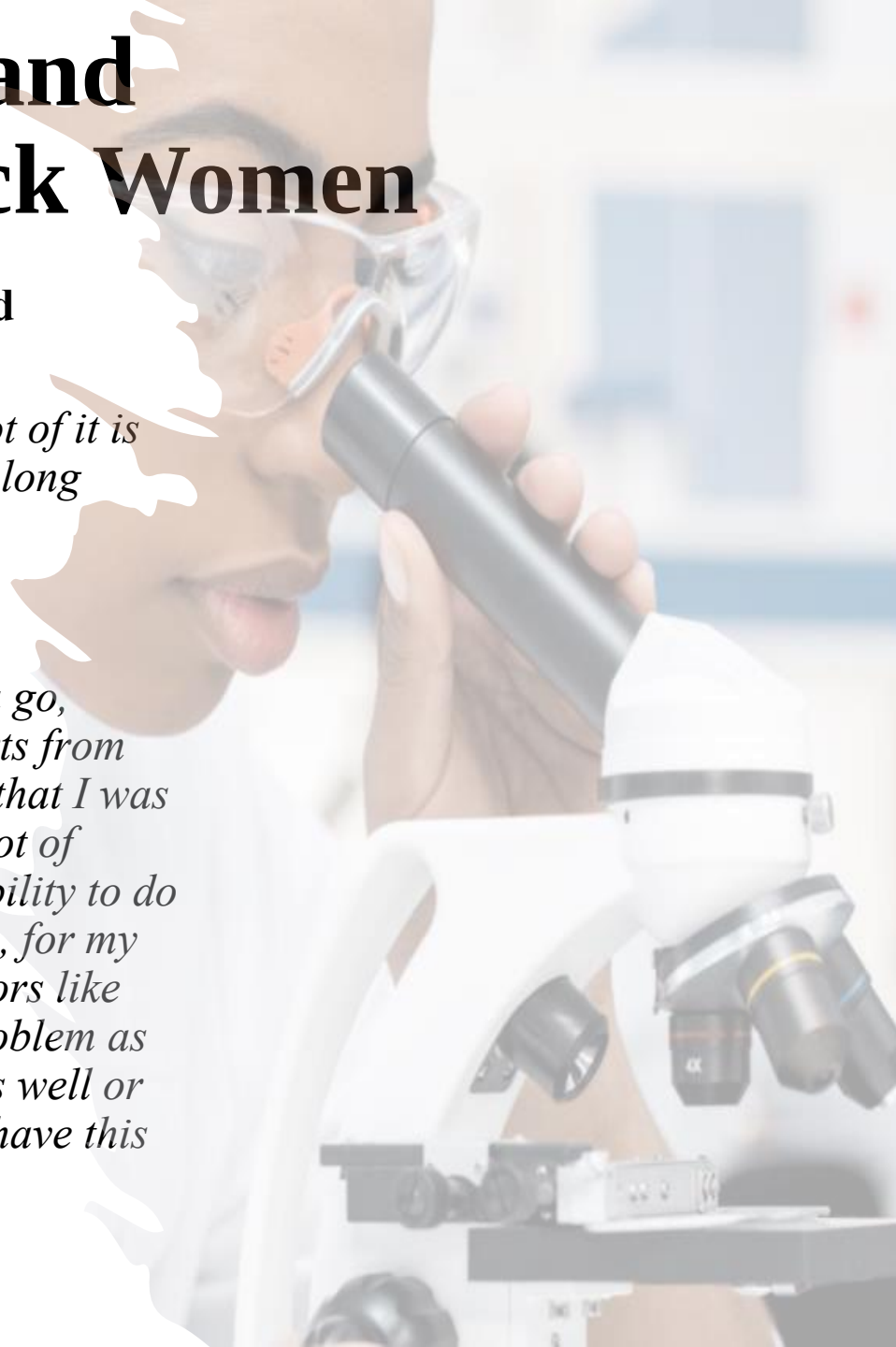
How would you describe the culture of science, technology, engineering, and mathematics (STEM) as a whole?

One way I would describe it is, I would say, catered to the majority…I think a lot of it is gate-keeper is the word, for so long we weren't allowed into those spaces for so long

~Brianna, African American female, Sophomore, Biology major

I was like gatekeeper everywhere and it's more like experiencing the places you go, especially in the STEM community. Even I just kind of realized how much it starts from the beginning even elementary or middle school levels, and I really did not feel that I was that great at science until probably college and even though I did, as well as a lot of people in my class it didn't feel like it. It felt like people were surprised by my ability to do well, so it just felt like it was like a fluke I guess you could say but with that, like, for my other classmates there weren't a ton of resources, or like checking with instructors like checking to see like how everyone's doing or like really trying to find the key problem as to why we weren't understanding things …A lot of that sometimes we don't do as well or things happen due to family circumstances and people forget that and they just have this mindset that it has to be this way because we have a majority population that is participating in science and STEM at the moment.

~Danielle, African American female, Senior, Biology major



<u>THE DOUBLE BIND</u>: THE PRICE OF BEING A MINORITY WOMAN IN SCIENCE
Malcom, Hall, & Brown, 1976

- Dr. Shirley Malcom, 1976, trailblazing report from the American Association for the Advancement of Science
- Minority women were the victims of two problems within science context: racism and sexism = “Double Bind”.

*“Minority women represent a disturbingly small part of the total scientific manpower pool, but are a significant component whose needs seem not to have been addressed by existing programs for minorities or women. They have traditionally been **excluded** because of biases related to both their **race or ethnicity** and **gender**, constituting a **<u>double bind</u>**. Programs for minorities and women have generally been assumed to include minority women, but in fact minority women fall in the cracks between the two. The programs designed to increase the number of women in science have been largely devoted to assisting majority [White] women. The programs developed for minorities in science have mostly been dominated by male scientists [African American/Black]. Similarly, the women's science organizations are overwhelmingly white, and the minority science organizations, overwhelmingly male.”*

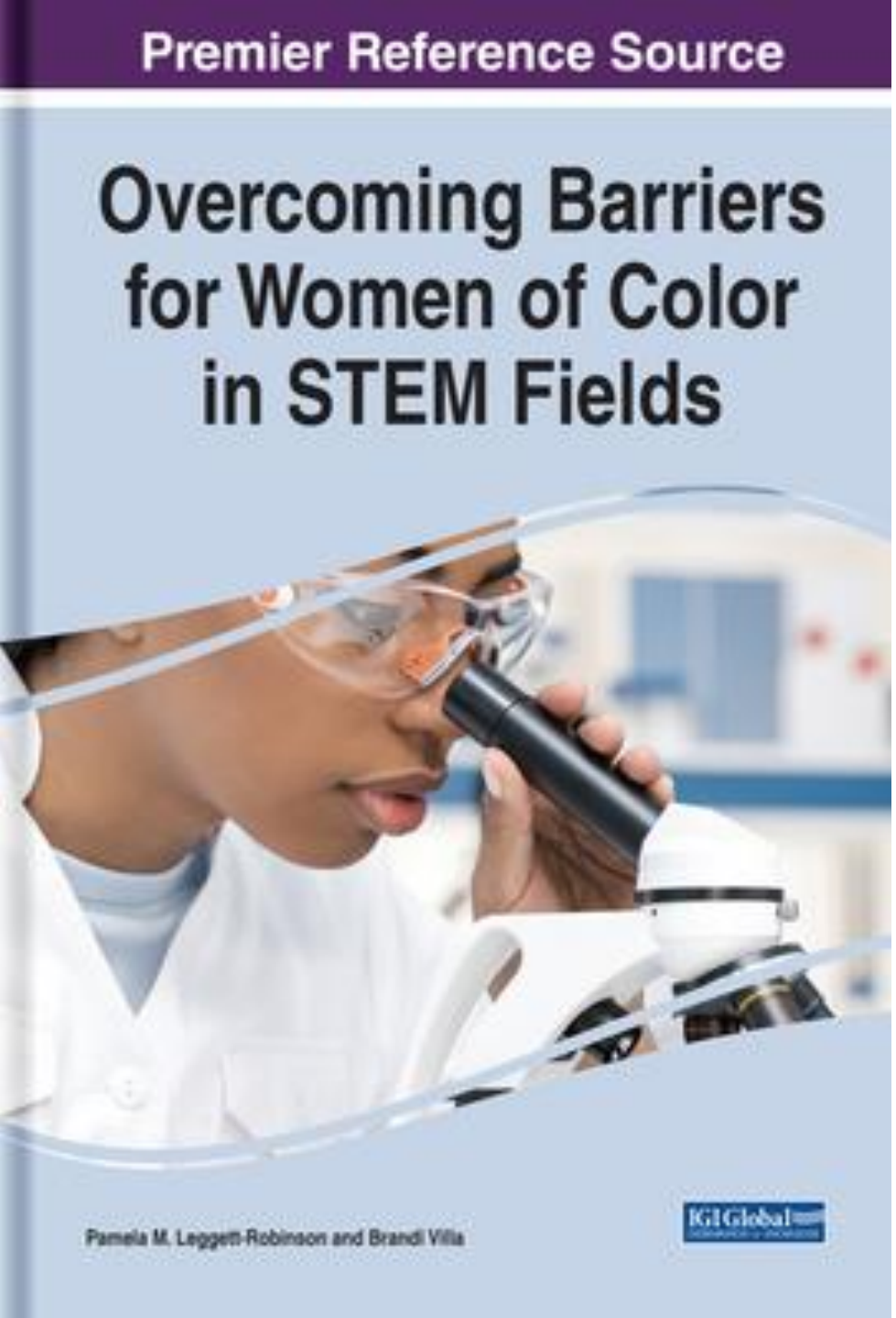
Theorizing Intersecting Identities

Intersectionality

(Crenshaw, 1991)

Black Feminist Thought

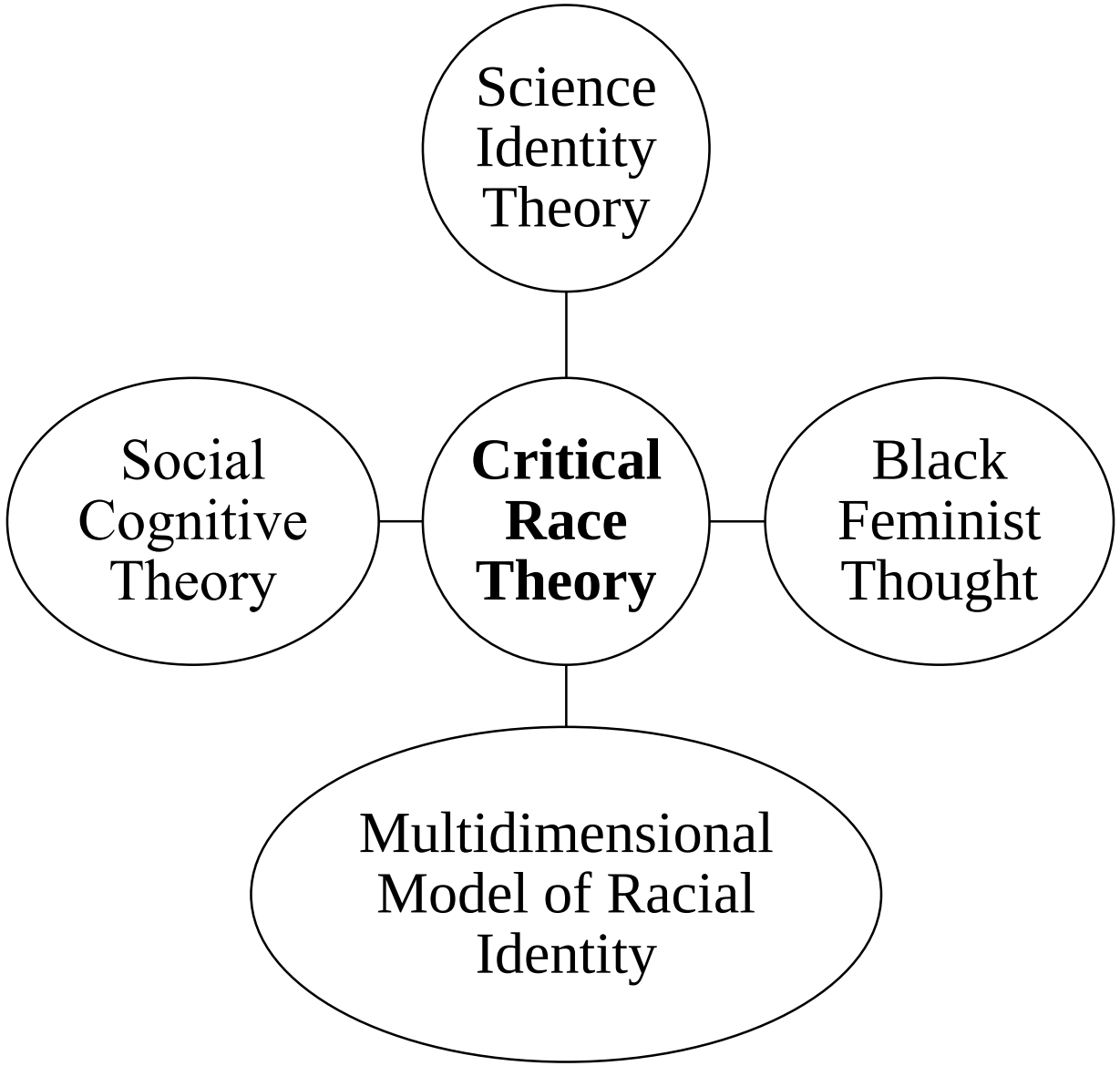
(Collins, 2000)



Negotiating Intersectionality: The Triple Pressure of Being an African American Female Scientist

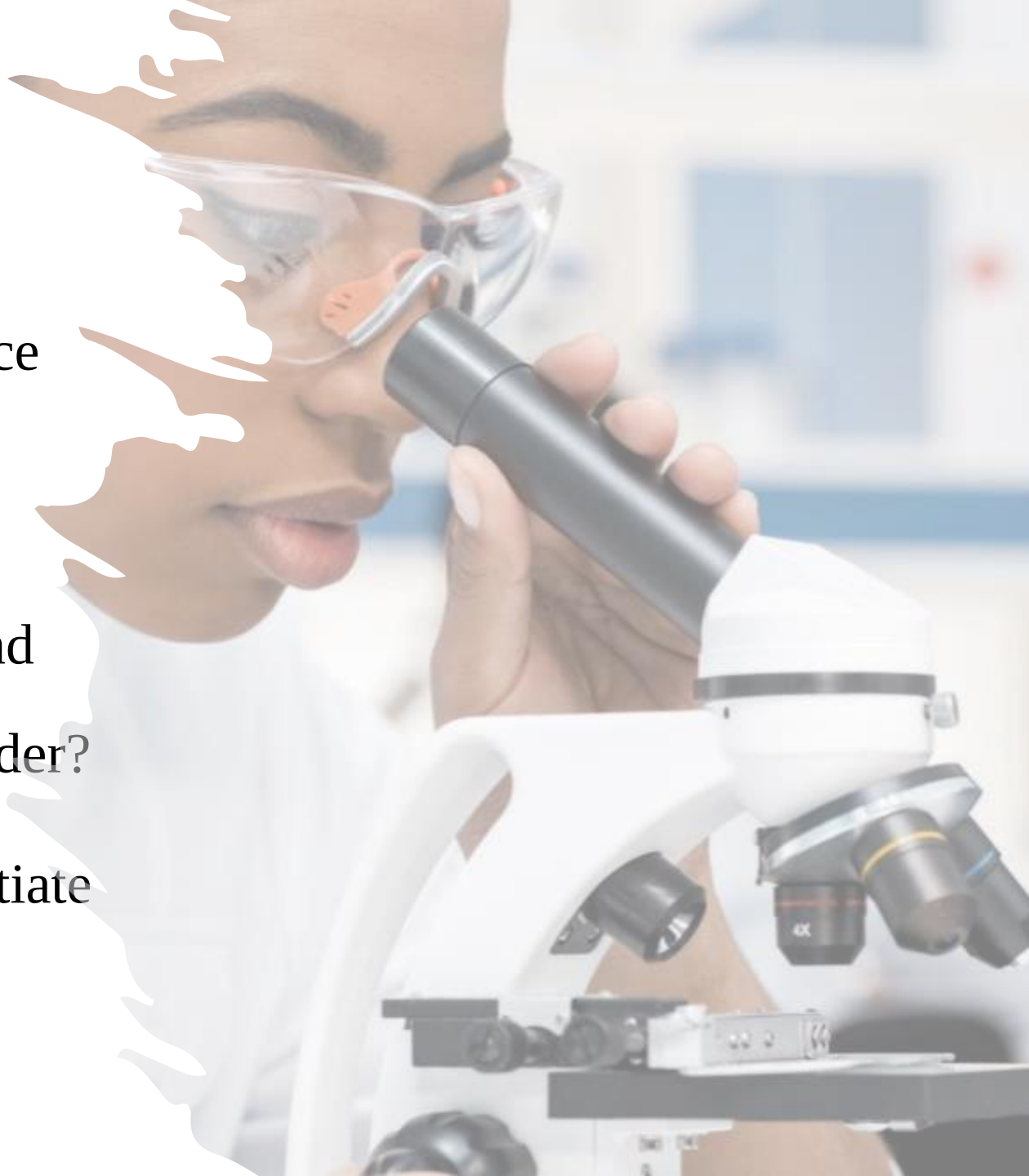
- To investigate the interactions between the racial identity, science identity, and science self-efficacy beliefs of African American females pursuing science degrees at HBCUs.
- To explore how HBCUs help African American female students negotiate the intersection of their racial, gender and science identities.

Theoretical Framework



Research Questions

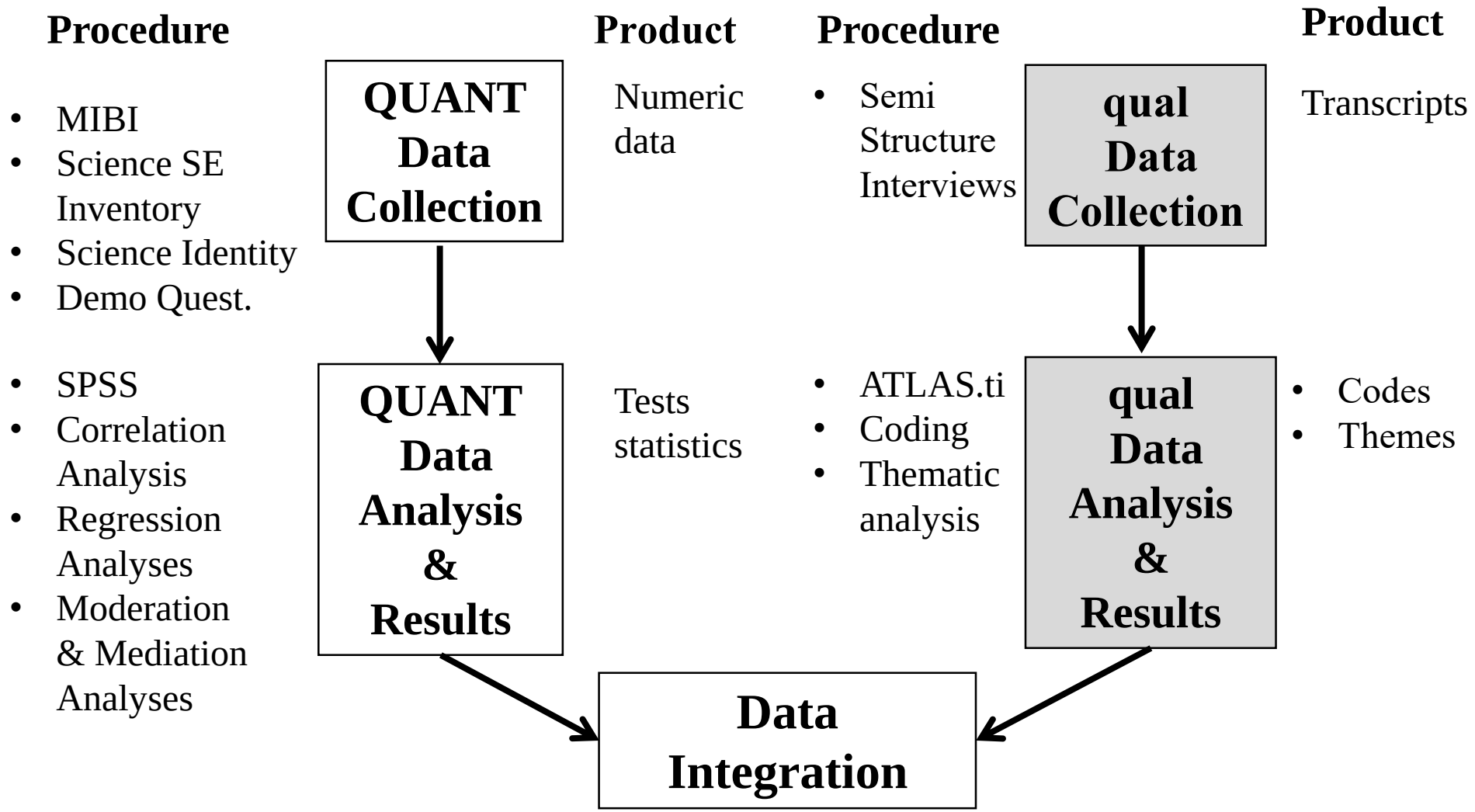
- What is the relationship between the science self-efficacy beliefs, science identity, and racial identity of African American female students attending HBCUs?
- Is there a difference in the interactions between science identity, racial identity, and science self-efficacy of African American students attending an HBCU based on gender?
- What is the role of the HBCU context in helping African American females to negotiate the intersectionality of their gender, racial identity, and science identity?



Research Study Sample

- **QUANT Component:**
  - ***n* = 347**: female (*n* = 267, 67%), while 79 (20%) were males
  - Self-identified African American
  - Science majors: biology, chemistry, physics and pharmaceutical sciences
  - Sophomores, Juniors, Seniors
  - Five southeastern HBCUs
- **qual Component:**
  - *n* = *9* African American females from four of the five institutions

Methodology: Critical Race Mixed Methods QUANT + qual



Results: QUANT Phase

Table 1

Pearson Correlation Matrix among Science Identity, Science Self-Efficacy, Assimilation (Racial Identity) for African American Females at HBCUs

Variable	1	2	3	4	5
1. Assimilation	-				
2. Nationalist	0.04	-			
3. Science Identity	0.22*	0.05	-		
4. Science Self-Efficacy	-0.04	0.00	-0.38*	-	
5. College Science GPA	-0.22*	-0.17*	0.06	-0.24*	-

Table 2

Pearson Correlation Matrix among Science Identity, Science Self-Efficacy, Assimilation (Racial Identity) for African American Males at HBCUs

Variable	1	2	3	4	5
1. Assimilation	-				
2. Nationalist	-0.19	-			
3. Science Identity	0.17	-0.04	-		
4. Science Self-Efficacy	-0.07	0.07	-0.52*	-	
5. College Science GPA	-0.11	-0.07	0.47*	-0.45*	-

Results: qual Phase

- *I am not my hair…I can be myself*
- *Visible Yet Invisible*
- *Triple Pressure Leads to Proving*

I am not my hair…I can be myself

"I mean it helps out a lot, especially from my background, going to an all white high school. Everywhere you turn there's somebody that doesn't look like you, that you're the odd one out. And then coming here and seeing everybody looks like you and you're like wow! I can finally be myself. There's people here that actually understand me or I don't have to talk a certain way. I can be myself. I can dress this way without being looked upon…especially with my hair. I wear a lot of weave or a lot of braids and when I did that at my high school everybody would be looking at me like, "wow that's cool, how you do this or how do you"…Here it's different. I'm looking at them that same way because I see all of this natural hair. I love it!"

~Tiffany, sophomore Biology students at Jackson B. Southerland

Visible Yet Invisible

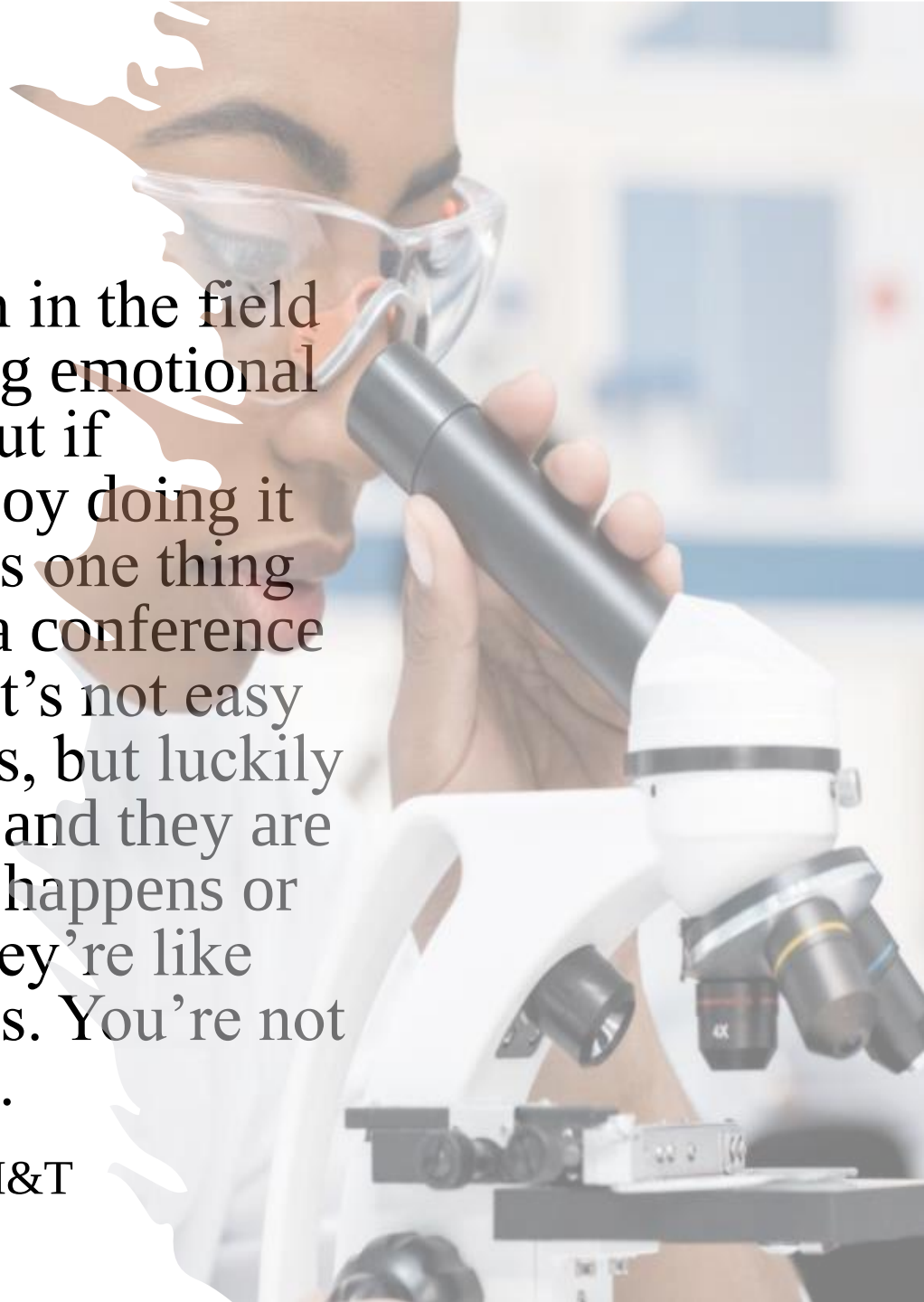
"It makes me inspired to continue on because I see that they did it *[aspirational capital]*. For example, my first biology teacher here was a Black woman and she's also a scientist. Like, she got her degree in microbiology. And now she currently chairs one of the research programs I am in. So, it's like a lot of things that she does is what I could **see myself doing**….**seeing our professors, you know, seeing what we can become if we keep going**. Seeing someone that looks like us. So, it definitely inspires me as a scientist."

~Patricia, junior Biology student at Calvin University

Visible Yet Invisible

"It's interesting because even with being a woman in the field is very different. Because women are seen as being emotional and all this. I'm not an extreme outright person, but if something excites me like my research when I enjoy doing it and talking about it, I'm going to show that. That's one thing that a lot of physicists are emotionless. Sitting in a conference is monotone. I hate that *[identity incongruence]*. It's not easy because there's not a lot of black female physicists, but luckily I have had a chance to meet a lot [at conferences] and they are like my mentors *[social capital]* now. If anything happens or any situation, I've had to reach out to them and they're like "we understand. We're here. There is a group of us. You're not alone"[*navigational capital*], so that's really good.

~Hannah, senior physics student at North Central M&T



Visible Yet Invisible

"I know it's like 2017 but it's still the same, even in class I notice like I'll say something and they're [white male faculty] like no that's not it but then a guy [who is also African American/Black] says something and they're like that's right, when he just said literally what I just said. I don't know, it's just weird being around a whole bunch of men and two girls [she and Hannah]. Maybe I've kind of pushed it to the back since it's been four years. **It's like whatever now but I noticed men look at each other when they speak and they kind of glaze over you**. **And then they'll look at you, then they'll glaze over you one.** Or one time they have me doing shopping stuff. I don't want to shop…Like it's just weird but yeah there's way more men out there in physics for sure. **Way more African American men than women out there**. "

~Shannon, senior Physics Student North Central M&T

What contribution did these scientists make to Biology?

Dr. Marie Daley

James Watson, Francis Crick & Rosalind Franklin

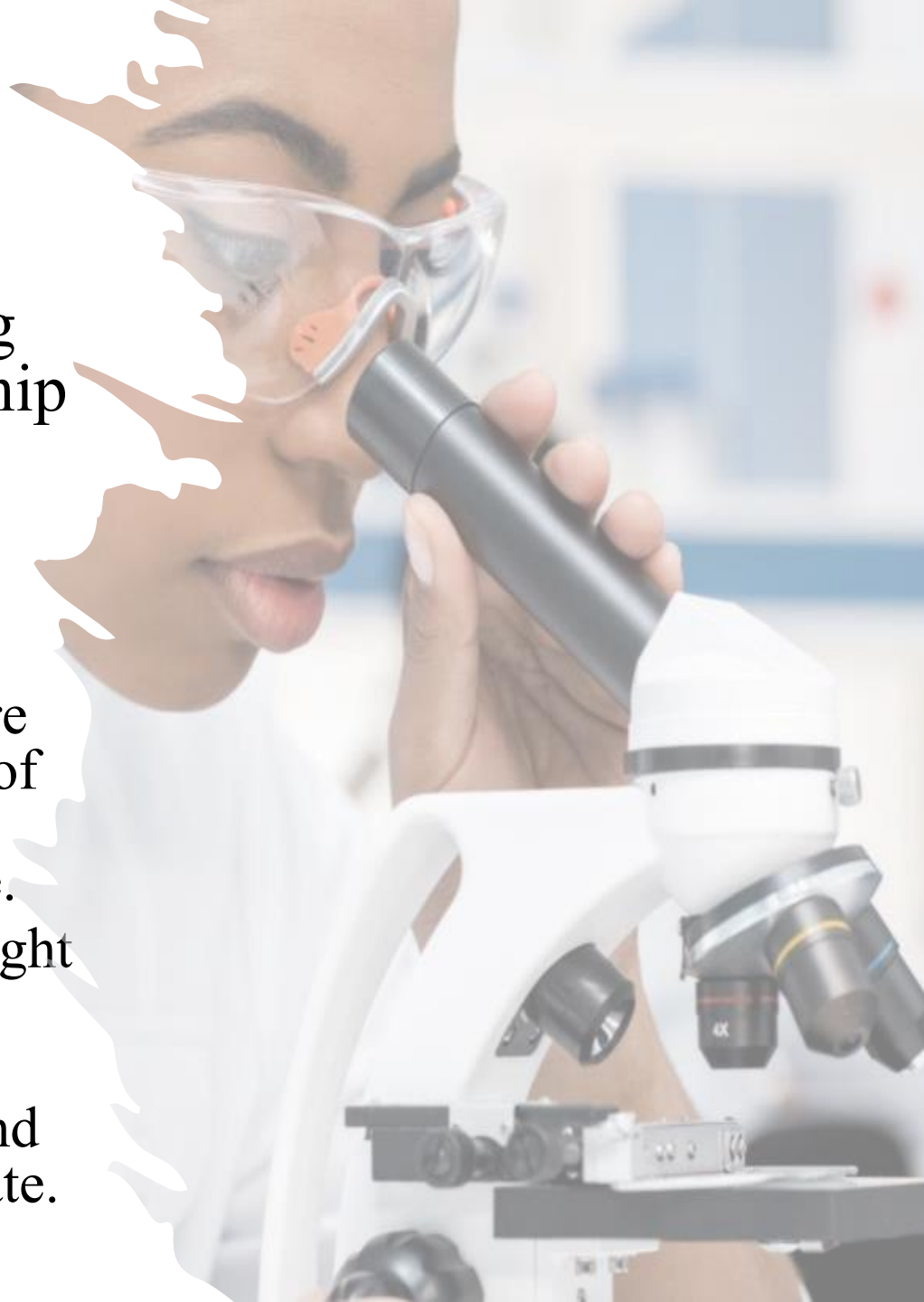
Triple Pressure Leads to Proving

“I think it’s pressure on being a better Black physicist and woman…**Triple pressure**. Because you’re a **woman** so you also have to **prove** that you’re good enough to be with the men. And you’re **Black** so you have to **prove** that you’re good enough to be with the White people. And then **physics**, you better know what you’re talking about. So it’s a lot of pressure…knowing that it’s a male dominated field and trying to be respected going into those things. “

~Shannon

Integrating the Quantitative and Qualitative Findings

- Qualitative data provided a fuller understanding of the statistically significant positive relationship between science identity and assimilation (r_p = 0.22, p = .002)
  - Power structures converge to exclude African American females from participating in science
  - African American male students have acquired more privileges than African American females because of their male status; therefore, there is not a need for them to Assimilate in order to participate in science.
  - CRT notion of whiteness as property, specifically right to use and enjoy
  - Privilege to participate in science within HBCUs is alienable first to African American males and second to African American females who strongly assimilate.



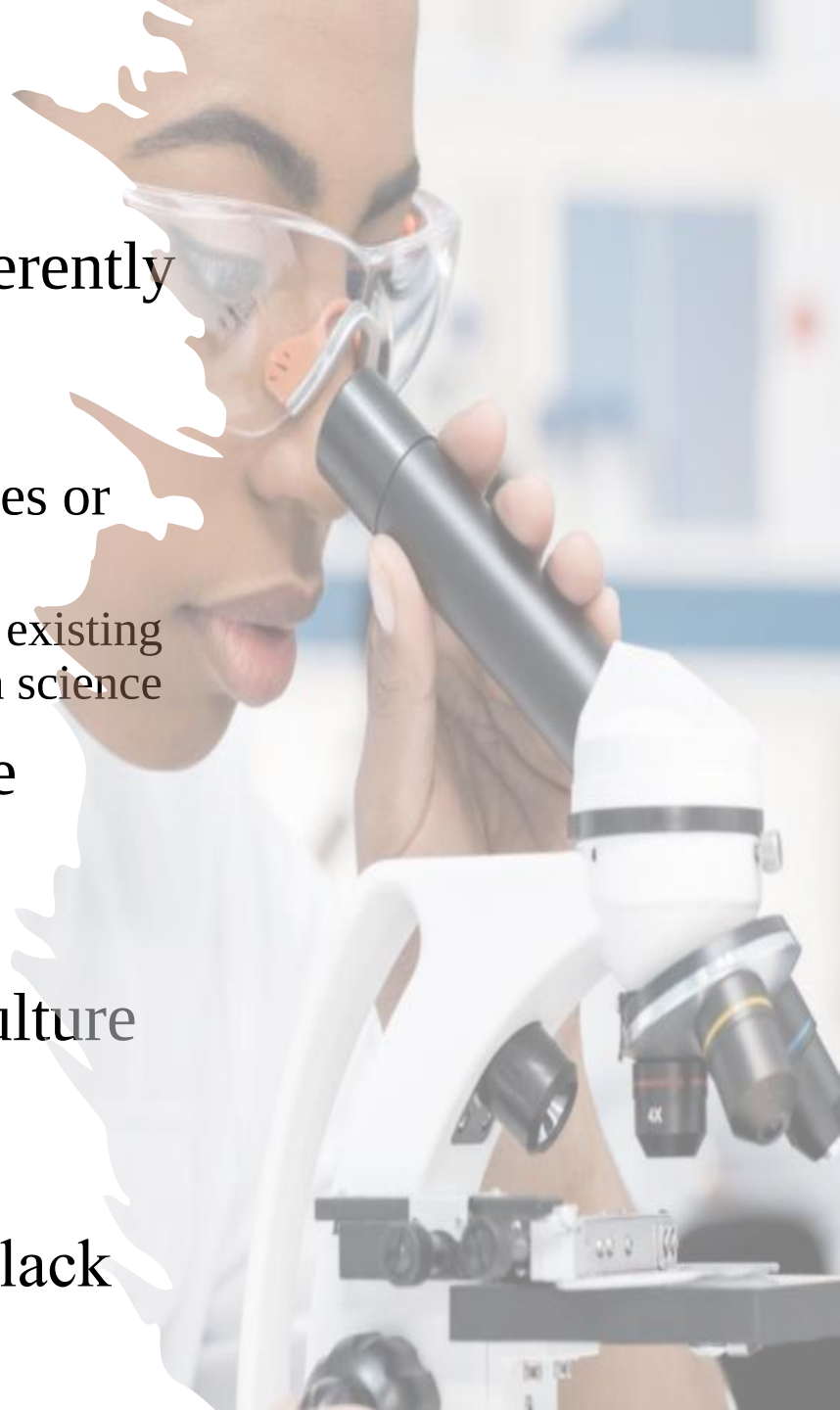
Integrating the Quantitative and Qualitative Findings Strategic Assimilation and Counterspaces

"At NSBP, National Society of Black Physicist conferences, I guess **it's more relaxing** in a sense for me. To be in a space where it's other physicists of color and I can **enjoy it more** in a sense because **we have this understanding** whereas other conferences like SPS Society of Physics Students is just more white physicists. **Your typical physicists**. **It's different** when an older white guy comes to your poster and is asking you all these questions and it's not really like they want to know more about your research or just want to know what you know. It's like you're trying to **prove yourself** in a sense. **Through the years I have found ways to flip the tables** *[navigational capital]*. That's one major difference is how you handle that one-on-one conversation at your poster. **Different between people testing your knowledge versus actually being interested in your research."**

~Hannah

Discussion

- African American women experience science contexts differently from African American males, even within HBCUs
  - AA Males acquire privileges – conferred whiteness
  - AA Females must strategically adopt masculine and White attitudes or dispositions
    - Adopt the assimilation ideology as both a copy strategy and disrupt the existing systems of oppression that operate against African American females in science
- Lack of visibility of and access to African American female faculty further reifies the notion of whiteness as property, specifically the right to exclude and include.
- Given critical attention to transforming the structure and culture of science
- Intentionally integrate the lived experiences "realities" and knowledge (or "ways of knowing") of African American/Black female students into the curriculum/learning experiences



Counterspaces in Science

- Ong et al., 2017
- Counterspaces in STEM are typically considered “safe spaces” positioned at the margins for groups outside the mainstream of STEM education
- Counterspaces can be physical settings, conceptual, and ideological; Academic and Social
- Peer-to-Peer Interactions/Relationships: Informal or formal relationships with other marginalized members
- Mentoring relationships
- STEM and Non-STEM Student Organizations
- Conferences designed for marginalized/underrepresented groups in science

Justice-Centered Science Pedagogy

- Built on the traditions of Critical Pedagogy and Culturally Relevant Pedagogy to address inequities along the lines of race and class as a components of larger oppressive systems
- This framework positions students of color as transformative intellectuals who display complex thinking about science and social justice issues, cultivates their commitment to their communities and cultures of origin, and develops credibility as youth knowledgeable in science (Morales-Doyle, 2017)
- Recognizes that students must master and critique sanctioned Western forms of scientific knowledge to be participants in the science community and society while simultaneously leveraging science education as a catalyst for social change.

Equity Ethic: “Doing it for Us”

- **Equity Ethic (McGee, 2020):** A set of moral values that includes a principled concern for justice, particularly racial justice, for addressing racial inequities, and for the well-being of people suffering under various inequities.
  - Students in STEM demonstrate their equity ethic as intentions or actions taken to use their STEM-specific skills and positions to address equity concerns.

Jenay: *“I chose to go into the sustainability and land system sector because, in the future, I would like to own my own farm and also look towards black activism on land redistribution and food desert issues, so I was looking to bring more sustainability and opportunity inside the black community. I wanted to work, to be more knowledgeable about methods for in-house farming and how you can have a more sustainable and healthy productive crop yield at home.”*

Dr. A White: “So where did the interest come from”

Jenay: *“Basically, it just came from, in St Louis Missouri, like it’s clearly a very segregated area, and you may not be aware, something called the Del Mar divide, so, it’s like on one side of Del Mar there are literal mansions if you drive less than 15 minutes, The south direction, you know that's the entry to the hood is you know, a grocery store every 10 miles. It's just really like you know unfortunate and unnecessary in very clear purposeful tactics to keep black people in you know just living in a state of discomfort and it just really affects your mind like you, are your environment, and you know kids could just be growing up in such more beautiful environments.”*

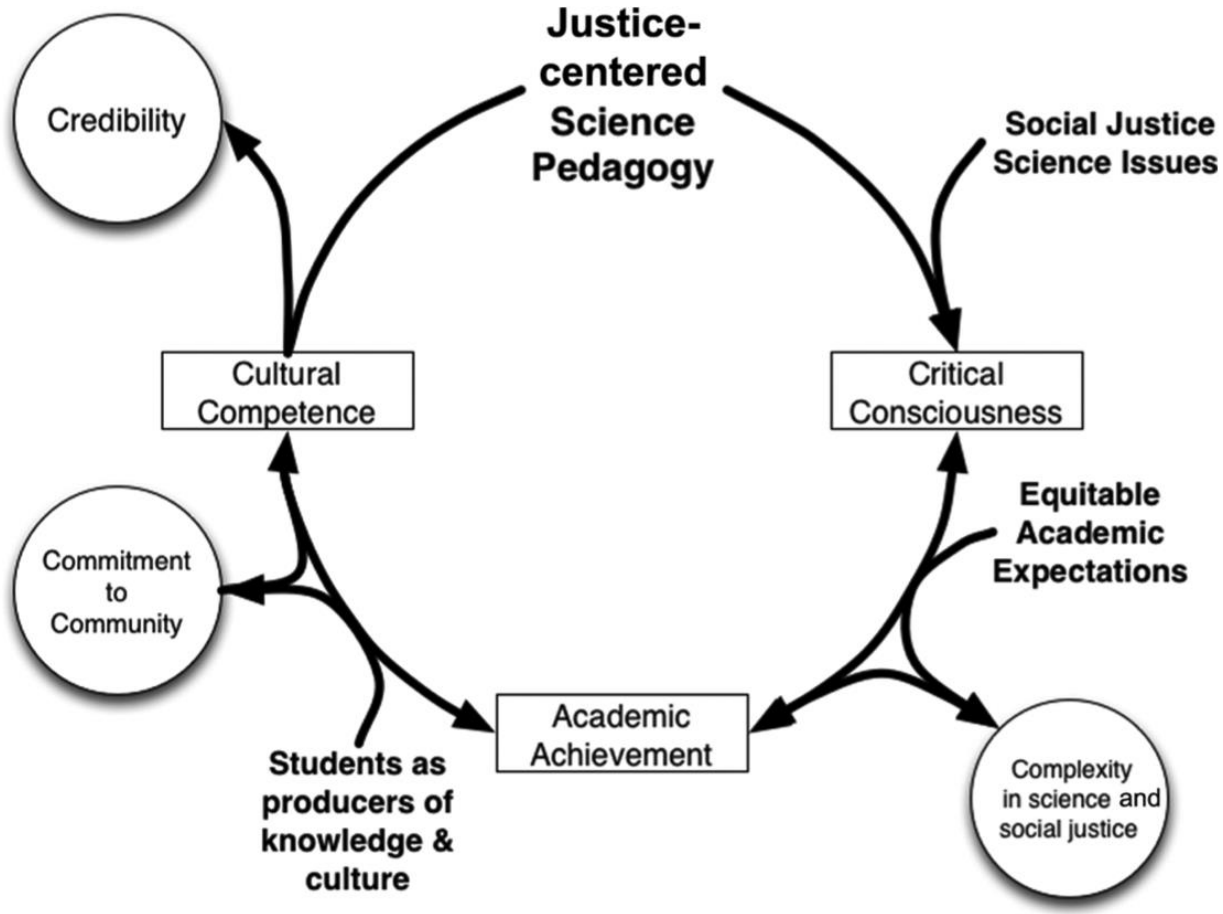


FIGURE 2 Justice-centered science pedagogy, as a catalyst for social transformation, positions students as transformative intellectuals who exhibit complexity, commitment, and credibility

Thank You and Questions

@AngelaW9777

Intersectionality Foundational References

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