

PERCEIVED BARRIERS AND ENDORSEMENT OF STEREOTYPES AMONG ADOLESCENT GIRLS OF COLOR IN STEM

Allison Scott, Ph.D.
Alexis Martin, Ph.D.



LEVEL PLAYING FIELD
INSTITUTE

Presentation Agenda

- ▣ Overview of Underrepresentation and Barriers for Girls of Color in STEM
- ▣ Examine Research Findings
 - Perceived Barriers to Entry and Success in STEM
 - Endorsement of Negative Stereotypes about Ability in STEM
- ▣ Discuss Implications for Improving STEM Outcomes for Girls of Color



Underrepresentation in STEM (Science, Technology, Engineering, Mathematics)

- ❑ Significant underrepresentation by both race and gender in STEM fields.
- ❑ In secondary education:
 - African-American and Latino students comprise just **15%** of all AP Math and Science exam takers (College Board, 2012)
 - While they make up **57%** of the high-school aged population in California, African-Americans and Latinos comprise just **9%** of the AP Computer Science exam takers (College Board, 2012).
 - **Females** represent only **20%** of all California AP Computer Science exam takers (College Board, 2013).
- ❑ In post-secondary education:
 - **African American and Latina women combined** earn just **10%** of all science and engineering degrees and only **5%** of all computer science degrees (NSF, 2010).
- ❑ In the workforce:
 - African Americans and Latinos comprise just **9%** of the entire U.S. science and engineering workforce; **African American and Latina women combined** represent just **2%** of the science and engineering workforce (NSF, 2006, 2012).



Structural Barriers to Pursuing STEM

- ❑ Disparities in K-12 STEM education affecting underrepresented girls of color include:
 - ❑ Inequitable school funding (EdTrust West, 2012)
 - ❑ Lack of access to science resources and facilities (WestEd CFTL, 2011)
 - ❑ Lack of access to high-quality teachers (Darling-Hammond, 2004; U.S. Dept of Ed., 2008)
 - ❑ Inequitable access to computer science courses (Margolis et al., 2008)
 - ❑ Lack of opportunity to engage with technology to solve problems, conduct experiments, or create products (Goode, 2010; Gray, Thomas & Lewis, 2010)
 - ❑ Unequal access to advanced coursework (College Board, 2012)



Social/Psychological Barriers to Pursuing STEM

- **Stereotype threat** has been shown to negatively impact test performance of African Americans (Steele & Aronson, 1995), math performance among women (Spencer et al., 1999). Stereotype threat also negatively affects attitudes, engagement, and identification within negatively stereotyped domains.
- **Implicit bias**, or discriminatory biases based on unconscious (implicit) attitudes or stereotypes, can limit opportunities and can also affect the decisions of marginalized groups to not pursue certain fields.
- **Lack of same-race or same-gender role models** can negatively affect STEM aspirations and reconfirms negative stereotypes about fields (e.g., what does a scientist look like?; Stout et al., 2011).
- **“Chilly Climate”** or the report of hostile, unfriendly environments when an individual is one of a minority group (e.g. women in science labs).



The Double-Bind

- In STEM, women of color experience the “double-bind” of having the **combination of two marginalized and negatively stereotyped identities** (Malcom, Hall & Brown, 1976).
- While research suggests that both race and gender separately impact perceived ability, aspirations, and performance, there is a lack of research on the “**double-bind**” in STEM.
- Dual identities and identity salience:
 - ▣ In a negatively stereotyped domain, which identities are more salient?



Research Questions

- To what extent do high-achieving students of color perceive internal and external barriers to pursuing STEM studies in post-secondary education? How do these perceived internal and external barriers vary by gender?
- To what extent do girls of color endorse negative racial and gender stereotypes about ability in STEM fields? What impact does endorsing negative stereotypes about one's own racial or gender group have on attitudes towards math and science, self-efficacy, and future STEM aspirations?



Context

- 5-week, 3-year STEM-focused summer program.
 - ▣ Rigorous math, science, and STEM elective coursework
 - ▣ College preparation and success courses
 - ▣ Exposure to diverse STEM role models
- Serves low-income underrepresented high school students of color
- Student Population: $n=152$ students
 - ▣ 51% male, 49% female
 - 46% Latino
 - 25% African-American
 - 29% Southeast Asian/Multiple Response/Other
 - ▣ Free/Reduced Price Lunch-eligible: 64%
 - ▣ First-generation college-bound: 67%



Study Instruments



□ Pre-post program survey scales included:

- Perceived External Barriers
- Perceived Internal Barriers
- Confidence in Overcoming Barriers
- Attitudes towards Math
- Attitudes towards Science
- Self-Efficacy in Math
- Self-Efficacy in Science
- STEM Career Aspirations
- Confidence in Achieving Aspirations
- STEM Racial Stereotypes
- STEM Gender Stereotypes

Focus group questions:

- Examined student perceptions of barriers in preparation, anticipated bias/discrimination based on race or gender, perceptions of racial and gender differences in math and science ability, and strategies to cope with obstacles and barriers.
- Verbal and written responses to prompts.







Summary of Findings

Perceived Barriers to STEM Fields of Study

- Findings demonstrated evidence of a “double-bind,” where female students perceived significantly higher levels of internal and external barriers than males.
- The most frequently perceived internal barriers included: **feeling not as smart** as other students (46%) and **not feeling prepared** enough to succeed in STEM (41%). The most frequently perceived external barrier was the fear of being **treated differently based on race** (45%).
- Females reported higher levels of each of the internal and external barriers than males.
- Gender differences existed even when removing the question specifically addressing perceived future gender discrimination.

Studying STEM in college, I will probably have to deal with... (% strongly agree/agree)		Male	Female	M-F Diff	Total
INTERNAL ($\alpha=.88$)	...Not being as smart as other students	42%	52%	10	46%
	...Not having enough confidence	26%	44%	18	35%
	...Not fitting in	27%	33%	6	30%
	...Not being prepared enough	34%	51%	17	41%
EXTERNAL ($\alpha=.87$)	...Teachers thinking I am not as smart as other students	33%	51%	18	34%
	...Being treated differently because of my gender	5%	43%	38	24%
	...Being treated differently because of my race	38%	51%	13	45%

Endorsement of Negative Racial and Gender Stereotypes about STEM Ability

- 41% of female participants believed that Asians and Whites have a greater aptitude for math and science than their African American and Latino counterparts.
- Only 13% of female participants believed that men had a greater aptitude than women in math and science.
- Nearly twice as many females reported thinking of Asians and Whites as “very good” at math and science (in comparison to African Americans and Latinos; 63%), than those who reported thinking of men as those who are “very good” in comparison to women (36%).

	Variable Items	% Strongly Agree/Agree
Gender Stereotypes ($\alpha=.63$)	When I think of people who are very good at math and science, I am more likely to think of <i>men</i> than <i>women</i> .	36%
	When I think of people who are scientists/mathematicians, I am more likely to think of <i>men</i> than <i>women</i> .	59%
	When it comes to math and science, I believe that on average, <i>men</i> are better at math and science than <i>women</i> .	13%
Racial/Ethnic Stereotypes ($\alpha=.82$)	When I think of people who are very good at math and science, I am more likely to think of <i>Asians and Whites</i> (than <i>African American and Latinos</i>).	63%
	When I think of people who are scientists/mathematicians, I am more likely to think of <i>Asians and Whites</i> (than <i>African American and Latinos</i>).	65%
	When it comes to math and science, I believe that on average, <i>Asians and Whites</i> are better at math and science (than <i>African American and Latinos</i>).	41%

Endorsement of Negative Racial and Gender Stereotypes about STEM Ability (cont.)

- ❑ Negative racial stereotypes about STEM ability were endorsed by female students of color more frequently than gender stereotypes about STEM ability.
- ❑ The endorsement of negative racial stereotypes was significantly, negatively related to STEM career aspirations, while gender stereotypes endorsement was not significantly related to future outcomes.
- ❑ Negative stereotypes did not significantly impact self-concept/self-efficacy/attitudes toward math and science:
 - This suggests protective factors at play which allow for the endorsement of negative stereotypes about one's group without impacting individual beliefs and is consistent with findings suggesting marginalized groups employ a variety of techniques to protect their self-concept (Major et al., 1998).
- ❑ Because endorsement of negative racial stereotypes was shown to have a significant impact on STEM aspirations, this suggests a long-term impact rather than immediate (e.g. self-efficacy).



Can Negative Stereotype Endorsement be Reduced?

- Promising findings from a summer intervention reveal a significant decrease in endorsement of negative racial stereotypes as a result of participating in a STEM-focused intervention program
- The programming included a specific focus on counteracting stereotypes through STEM role models, building communities of diverse peers excelling in STEM, etc.





Recommendations for Increasing Equity for Underrepresented Girls of Color in STEM

- ▣ Expand programs that **develop early STEM interest** through hands-on experiences and extracurricular activities
- ▣ Increase **access and availability of rigorous STEM coursework** to ensure girls of color have opportunities to enroll in critical gatekeeper courses
- ▣ Expand **summer and afterschool programs** to provide STEM enrichment for girls of color
- ▣ Increase **exposure to diverse female STEM professionals, mentors, and role models** to counteract stereotypes about STEM aptitude and ability and decrease psychological barriers to pursuing and persisting in STEM.
- ▣ Develop **welcoming and inclusive STEM environments**, from classrooms to workplaces
- ▣ Build supportive **communities of peers of color** from same-gender and different-gender backgrounds with an interest in STEM
- ▣ Expand higher education programs that aim to **recruit and retain** girls of color in STEM, through research and mentorship opportunities

THANK YOU!

- Acknowledgements: We would like to thank the individual, corporate, and foundation sponsors who provide support for the Level Playing Field Institute's research and programming.

- For more information about this study or related research and STEM programming for high-school students:
 - Allison Scott, Ph.D., allison@lpfi.org
 - Alexis Martin, Ph.D., alexis@lpfi.org

