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GENDER AND RACIAL STEREOTYPE ENDORSEMENT: EXAMINING THE IMPACT ON STEM OUTCOMES AMONG HIGH-ACHIEVING UNDERREPRESENTED ADOLESCENTS

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Context for Study

□ Vast underrepresentation of African Americans, Latinos, and women in Science, Technology, Engineering, and Mathematics

□ Pervasive cultural stereotypes about the intellectual inferiority of racial minorities and women in math and sciences and superiority of whites, Asians and males.

Implications of Negative Stereotypes and Negative Stereotype Endorsement

- Negative stereotypes about racial minorities and women have been shown to have numerous detrimental effects, including:
    - decreased test performance (Steele & Aronson, 1995)
    - disidentification with math and science (Nosek, Banaji, & Greenwald, 2002)
    - disengagement from negatively stereotyped domain (Steele, 1997; Davies et al., 2002)
- Negative stereotype endorsement , or internalization of stigma, has been associated with:
    - decreased self-esteem and self-concept (Okeke et al., 2009; Schmader, Johns, & Barquissau, 2004),
    - reduced effort to develop counter-stereotypic skills (Burkley, 2007),
    - lower math identification (Burkley & Blanton, 2009), and
    - less interest in continuing the pursuit of studies in math (Schmader, Johns & Barquissau, 2004).
- Negative in-group stereotyping can also potentially play a protective role in buffering self-esteem in face of failure (Burkley & Blanton, 2008).
- Among female high school students of color, endorsement of negative racial stereotypes was negatively associated with STEM career aspirations, while gender stereotype endorsement was not (Scott & Martin, 2013)
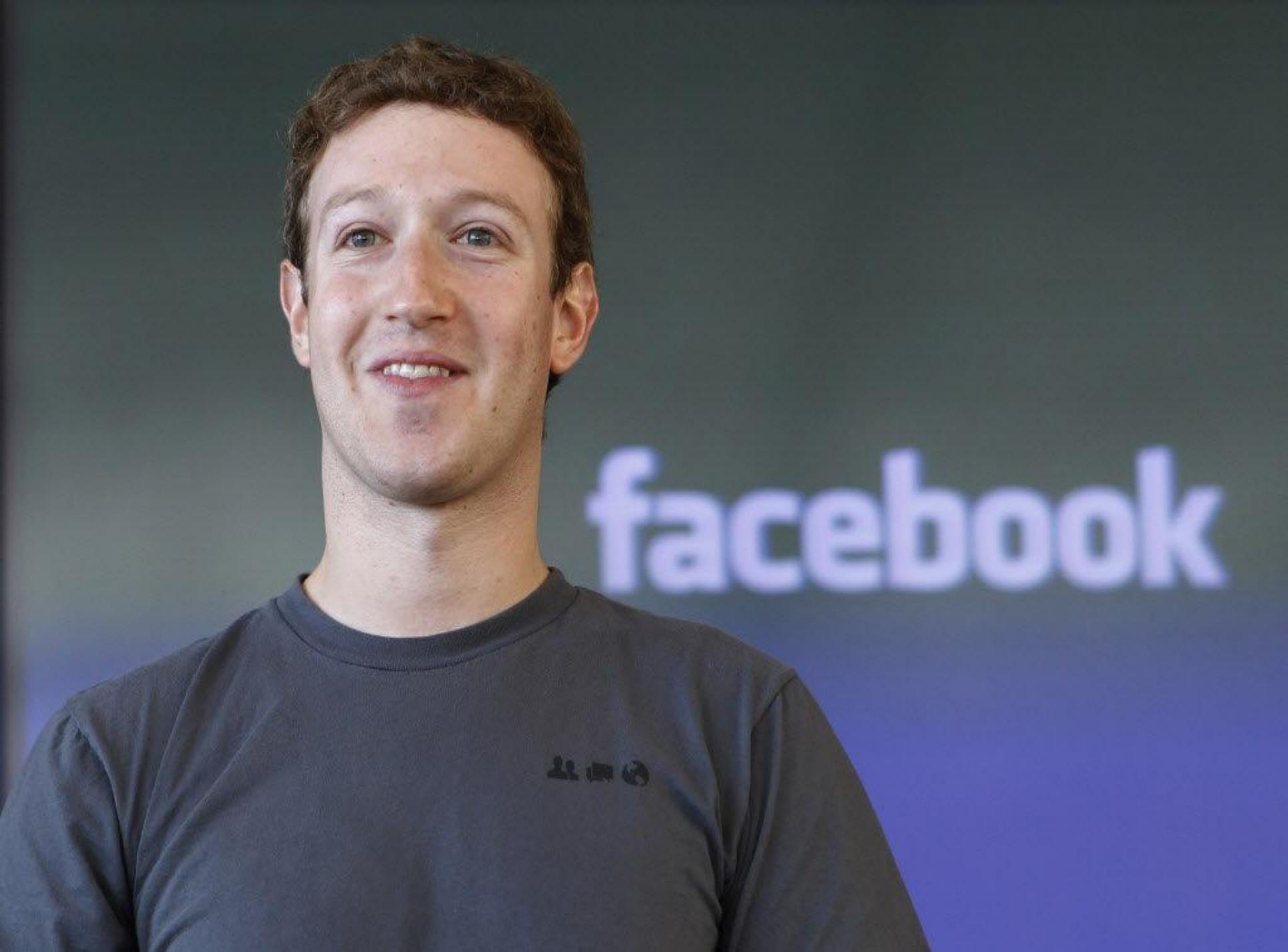
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Research Questions

- To what extent do high-achieving students endorse negative racial and gender stereotypes about the STEM aptitude and ability of their own racial/gender group?

- What relationships exist between the endorsement of negative racial or gender stereotypes and STEM attitudes, identification with STEM, and future STEM aspirations?

- Is a 5-week STEM intervention program effective in decreasing the endorsement of negative stereotypes about STEM ability?

Theoretical Framework

- Levels of Racism (Jones, 2000)

- Mechanisms of Stigmatization (Major & O'Brien, 2005)

- Stereotype Threat (Steele & Aronson, 1995)

METHODOLOGY

Program Context

- 5-week, 3-year STEM-focused summer program

- 4 sites in Northern and Southern CA

- Serves low-income, first-generation, high school students of color

- Programming includes:

  - Core mathematics (Algebra II, Pre-Calculus, Calculus) and science (Biology, Chemistry, Physics) courses

  - 3-year AP Computer Science preparatory sequence of courses (CS1, CS2, CS3)

  - College success classes, youth development curriculum (e.g., leadership, public speaking)

  - Project-based learning, culturally relevant pedagogy, and technology


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Participants

- n=223
- **Grade:**
  - 9th (37%)
  - 10th (45%)
  - 11th (18%)
- **Socioeconomic Status:**
  - FRPL-eligible: (83%)
  - First-in-Family to complete college (81%)
- **Residence:**
  - San Francisco Bay Area (58%)
  - Los Angeles Area (42%)
- **Type of School:**
  - Public school 93%
  - Private school 7%
- **Student Achievement:**
  - Average incoming math grade A-

Race/Ethnicity (n=223)

- African American
- Latino
- Filipino
- Southeast Asian
- Mixed Race/Multiple Response

5% 4% 5%

28%

57%

Gender (n=223)

- Male
- Female

49% 51%
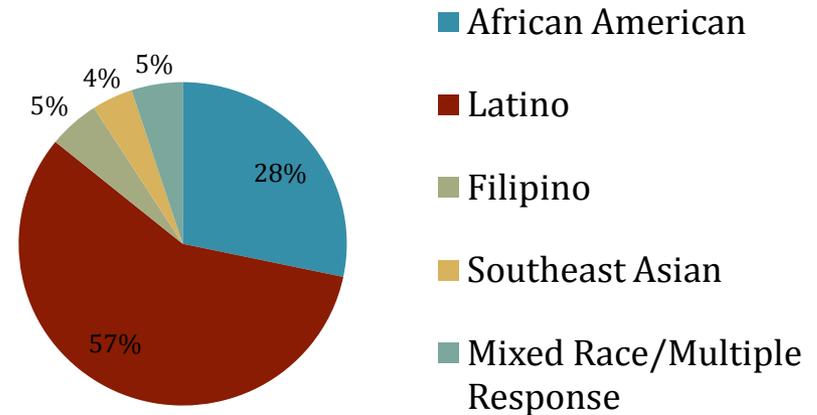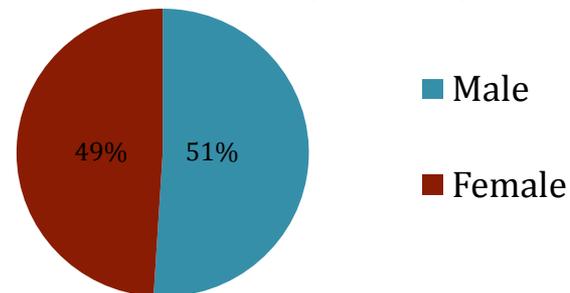
Data Collection and Analysis

- Quantitative data were collected through pre- and post-program student surveys

- Scales included:
  - STEM Racial Stereotypes (α=.82; 3 items)
  - STEM Gender Stereotypes (α=.89; 3 items)
  - Attitudes towards Science (α=.84; 2 items)
  - Attitudes towards CS (α=.88; 2 items)
  - Identification with Science (α=.72; 4 items)
  - Identification with CS (α=.68; 2 items)
  - STEM Career Aspirations (α=.90; 2 items)
  - CS Aspirations (α=.80; 3 items)

- Descriptive and multivariate analyses were conducted

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OVERVIEW OF FINDINGS

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Endorsement of Negative Racial and Gender Stereotypes about STEM Ability

		Variable Items	% Strongly Agree/Agree
Gender Stereotypes (α=.89)		Women are less capable of success in STEM than men.	9%
		Men have better math and science abilities than women.	12%
		Men are smarter than women.	13%
Racial/Ethnic Stereotypes (α=.82)		African Americans and Latinos are less capable of success in STEM than Whites and Asians.	20%
		Asians and Whites have better math and science abilities than African Americans and Latinos.	22%
		Asians and Whites are smarter than African Americans and Latinos.	13%

- Participants demonstrated significantly higher endorsement of negative racial stereotypes in STEM than gender stereotypes significant, t (222) =-5.05, p<.01.

- No differences by race, HS grade, FRPL, First-Generation; Negative gender stereotypes were significantly higher among males (F(1,221)=10.99, p<.01

- When examining female students only, STEM racial stereotypes were still endorsed at a significantly higher level than STEM gender stereotypes, t(107)=-5.36 p<.01.

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Endorsement of Negative Stereotypes and STEM Attitudes, Identification, & Aspirations

Criterion Variable: Attitudes towards Science	R^2	B	SE	F	t
Racial/Ethnic Stereotypes	.08	-.11	.06	4.44	-1.8
Gender Stereotypes	.08	-.10	.11	2.79	-.97
Criterion Variable: Attitudes towards CS					
Racial/Ethnic Stereotypes	.04	-.15	.07	2.59	-2.14*
Gender Stereotypes	.04	-.23	.11	1.61	-2.00*
Criterion Variable: Identification with Science					
Racial/Ethnic Stereotypes	.078	-.14	.05	4.60	-3.1**
Gender Stereotypes	.09	-.14	.07	3.46	-1.94*
Criterion Variable: Identification with CS					
Racial/Ethnic Stereotypes	.03	-.11	.06	1.77	-1.64
Gender Stereotypes	.01	-.31	.10	.19	-.32
Criterion Variable: STEM Career Aspirations					
Racial/Ethnic Stereotypes	.01	-.05	.06	.54	-.71
Gender Stereotypes	.02	-.08	.09	.84	-.82
Criterion Variable: CS Aspirations					
Racial/Ethnic Stereotypes	.06	-.12	.07	3.4	-1.68*
Gender Stereotypes	.04	-.17	.11	1.36	-1.59

*$p<.05$, **$p<.05$; Note: Only female students were included in the analysis of the relationships between gender stereotypes, attitudes, identification, and aspirations. All analyses included control variables of race and HS grade.

Can Negative Stereotype Endorsement be Reduced? Results from Summer Intervention

- Examined whether differences in STEM racial stereotype endorsement or gender endorsement decreased from time 1 (pre-program) to time 2 (post-program).

- Over the duration of the program, there was a marginally significant decrease in racial stereotype endorsement $(F(1,218)=2.98, p=.08)$.

- A marginally significant decrease in gender stereotype endorsement from pre- to post-program was present among males $(F(1,111)=2.96, p=.08$ but there was no significant intervention effect for females $(F(1,107)=.29, p=.58)$.

Summary of Findings

- *Endorsement of negative racial and gender stereotypes are present, even among high-achieving students.*
  - Approximately 1 in 5 students subscribed to the belief that Asians and Whites have greater aptitude and ability in STEM fields of study than African Americans and Latinos.

- *Racial stereotypes appear to be more salient.*
  - Negative racial stereotypes were endorsed with a significantly higher frequency than negative gender stereotypes (by both gender groups). This is consistent with previous research indicating that for girls of color, race is more salient than gender in endorsement of negative stereotypes (Scott & Martin, 2013).

Summary of Findings (cont'd)

- *The endorsement of negative racial and gender stereotypes are associated with a decrease in short-term attitudes and identification with STEM, and a decrease in long-term STEM aspirations.*
    - Negative racial and gender stereotypes are significantly related to less positive attitudes towards CS and lower levels of identification with science. The same directional relationships were seen for attitudes towards science and identification with computer science, but they were non-significant.
    - The endorsement of negative racial stereotypes were associated with decreased aspirations to pursue CS in college and career; No significant relationship with later STEM aspirations.

- *The impact of a summer intervention on decreasing stereotypes is promising, but more work needed.*
    - When examining the impact of the summer STEM intervention for reducing the endorsement of negative stereotypes, a marginally significant decrease in racial stereotype endorsement was found.
    - The intervention did not have a significant impact on decreasing the gender stereotype endorsement of males or females.

Limitations and Future Directions

- Relatively low levels of racial and gender stereotype endorsement: How to more accurately capture stereotype endorsement?
  - Create more robust racial and gender stereotypes scale (with items assessing stereotypes specific to gender and race within STEM) to provide information about which ideas are more heavily endorsed than others.
  - Examine implicit and explicit endorsement with more sophisticated measures
- Unique population and potential external validity issues
  - Conduct similar study with larger sample of "high-achieving" middle and high school students across multiple settings .
  - Conduct a comparison study with non-high achieving students to examine whether findings are consistent across populations and better inform STEM interventions.
- Mixed-results on effectiveness of intervention
  - Examine specific intervention components (e.g., diverse STEM role models) and their effectiveness in decreasing stereotype endorsement.
  - Examine ways to target intervention (see brief psychological interventions: Cohen et al., 2009, Cohen et al., 2006).

THANK YOU!!

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- For more information about this study or related research and STEM programming for middle and high-school students:
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