

# Adolescents' Fixed Mindset and Stereotype Concerns in Mathematics: Their Relations to Anxiety, Challenge Avoidance, and Achievement

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Evidence from prior lab-based studies has illustrated that when individuals are aware of negative stereotypes associated with their different identities, their performance is impaired on relevant tasks (e.g., women who were reminded about negative stereotypes regarding women's mathematics abilities performed worse on a mathematics assessment than women who did not receive this reminder).<sup>1</sup> Further, there have been an increasing number of field studies on students' naturalistic stereotype concerns in everyday life which were measured without experimental manipulation.<sup>2</sup> Most of these studies have been conducted on college campuses where it is convenient for researchers to recruit participants. It is, therefore, difficult to generalize the findings from these studies to people with different educational backgrounds or at various developmental stages such as high school students.

The current study is an important addition to existing research because it examines students' naturalistic stereotype concerns using a sample that enables claims about the U.S. population of 9<sup>th</sup> grade students in regular public high schools. Given the importance of 9<sup>th</sup> grade students' mathematics learning experiences to their choices related to college entrance and major,<sup>3</sup> it is critical to examine their experiences of stereotype concerns in mathematics classrooms at this stage of adolescence. Specifically, the study investigates the extent to which 9<sup>th</sup> grade students' self-reported concerns about racial/ethnic and gender stereotypes in mathematics predict mathematics anxiety, challenge avoidance, and achievement. To explore a psychological factor that may mitigate adolescents' stereotype concerns, the research also examines whether students' belief that mathematics ability is fixed and unchangeable, called a fixed mindset, is associated with mathematics stereotype concerns.

## STUDY DESIGN

Students self-reported their race/ethnicity and gender, stereotype concerns, fixed mindset, and levels of anxiety related to mathematics. Sample survey measures for these variables are included in Table 1.

## KEY FINDINGS

- Black and Latinx students reported greater concerns about racial/ethnic and gender stereotypes in mathematics as compared to their white peers.
- Students who endorsed the belief that mathematics ability is fixed and unchangeable reported greater concerns about stereotypes in mathematics.
- Students with greater mathematics stereotype concerns reported greater mathematics anxiety which, in turn, was related to lowered mathematics grades.
- Black and Latinx students who sought out more challenging problems during the behavioral task reported greater concerns about stereotypes in mathematics.

## RESEARCH TEAM

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*Areas of expertise:* educational and developmental psychology, education, human development

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**MINDSET  
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The National Study of Learning Mindsets Early Career Fellowship is a project of the Mindset Scholars Network and the University of Texas at Austin Population Research Center. The Mindset Scholars Network is a group of leading social scientists dedicated to improving student outcomes and expanding educational opportunity by advancing our scientific understanding of students' mindsets about learning and school. The University of Texas at Austin Population Research Center aims to provide outstanding infrastructure resources and sustain a dynamic interdisciplinary culture geared toward facilitating the highest level of population-related research among its faculty members and graduate and undergraduate trainees.

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## SAMPLE

This study leverages data from the National Study of Learning Mindsets (NSLM), the largest-ever randomized controlled trial of a growth mindset program in the U.S. in K-12 settings, in which a brief online growth mindset program was administered to 9<sup>th</sup> grade students during the 2015-2016 academic year. The NSLM features a nationally representative probability sample of regular U.S. public high schools.

The researchers used a subsample of the NSLM data, which consisted of key measures for black, Latinx, and white students in the control group who did not receive the growth mindset program. The researchers focused on black, Latinx, and white students as they historically have been the three largest racial/ethnic groups in the U.S.<sup>4</sup> and the most commonly studied in the stereotype threat literature.<sup>5</sup> This sample included approximately 5,180 students (7.8% black girls, 12.8% Latina girls, 8.6% black boys, 13.9% Latino boys, 27.7% white girls, 29.1% white boys). Additional information about the NSLM sample of schools and students can be accessed [here](#).

Using the survey, institutional, and behavioral task data, the research team first examined students' concerns about racial/ethnic and gender stereotypes in mathematics, broken down by student race/ethnicity and gender (black/Latina girl, black/Latino boy, white girl, and white boy). Second, they analyzed whether students with greater stereotype concerns experienced greater mathematics anxiety and engaged in greater challenge avoidance. In addition, they assessed if the mathematics anxiety and challenge avoidance, in turn, predicted students' later mathematics grades after controlling for the previous year's mathematics grades. Third, the researchers also tested whether fixed mindset predicted stereotype concerns. Finally, the researchers examined whether fixed mindset exacerbated the negative implications of stereotype concerns for psychological and academic outcomes in mathematics (i.e., anxiety, challenge avoidance, and grades).

## KEY FINDINGS

### ***Black and Latinx students reported greater concerns about racial/ethnic and gender stereotypes in mathematics as compared to their white peers.***

On average, black and Latinx students, regardless of their gender, reported greater concern that their mathematics ability would be evaluated based on their social positions. Black boys experienced greater concerns than Latino boys. There was no significant difference in stereotype concerns between boys and girls within each race/ethnicity.

### ***Students who endorsed the belief that mathematics ability is fixed and unchangeable reported greater concern about stereotypes in mathematics.***

That is, when students believed that being a "math person" is something that they cannot change, they were more likely to be concerned with the existing stereotypes associated with their racial/ethnic or gender identity. This result was found among black, Latinx, and white students regardless of their gender. The researchers, however, did not find the evidence to support their expectation that fixed mindset would exacerbate the negative effects of mathematics stereotype concerns on psychological and academic outcomes in mathematics.

### ***Students with greater mathematics stereotype concerns reported greater mathematics anxiety which, in turn, was related to lowered mathematics grades.***

The researchers observed this pattern among not only black, Latinx, and white girls but also boys, including white male students. The result suggests that white boys may feel "burden of proof"<sup>6</sup> when they are concerned about the relatively positive stereotype associated with their gender identity.

### ***Black and Latinx students who sought out more challenging problems during the behavioral task reported greater concerns about stereotypes in mathematics.***

Black and Latinx students, regardless of their gender, chose more challenging mathematics problems when they were concerned about mathematics stereotypes. This result may reflect their active attempt to disprove negative societal stereotypes associated with their race/ethnicity.<sup>7</sup> Stereotype concerns were not related to challenge avoidance among white boys and girls.

Table 1.

VARIABLE	SAMPLE SURVEY MEASURE
Stereotype concerns related to mathematics	In math class, how much do you worry that people's judgment of you will be affected by your race or ethnicity?
Fixed mindset related to mathematics	Please rate your agreement with the following statement: Being a 'math person' or not is something that you really can't change. Some people are good at math and other people aren't.
Anxiety related to mathematics	In general, how much does the subject of math in high school make you feel nervous, worried, or full of anxiety?

Challenge avoidance was measured using a behavioral "make-a-worksheet" task in which students chose from mathematics problems described as challenging (that offered the chance to learn a lot) or as easy (that would not lead to much learning). They were informed that they would complete the problems at the end of the session if there was time. The difference in the number of easy versus challenging problems a student chose to include indicated the level of their challenge avoidance. Finally, the data included institutional records of students' mathematics grades.

## INSIGHTS AND FUTURE DIRECTIONS

Students' concerns about mathematics stereotypes can have negative implications on their mathematics grades, and 9<sup>th</sup> grade mathematics achievement plays a crucial role in students' future educational and career choices. As such, the findings underscore the importance of future research examining contextual factors, such as teacher practices or curriculum features, that may mitigate or exacerbate students' stereotype concerns.

The study found that black and Latinx students were more concerned with mathematics stereotypes than their white peers, and they also demonstrated resiliency by showing less challenge-avoidance behavior when they were concerned with mathematics stereotypes. These findings support the notion that individuals may actively try to disprove or compensate for negative societal stereotypes associated with their social position.<sup>7</sup>

Another important insight the researchers gained was that stereotype concern may be relevant not only to adolescents with a negatively stereotyped social identity, but also to those with a positively stereotyped social identity. Based on the findings from lab-based studies, which often heightened students' stereotype concerns using a situational cue to activate stereotype threat (e.g., telling that men tend to score higher than women), the researchers expected to find that stereotype concerns would be closely associated with mathematics outcomes only among female students and/or youth belonging to underrepresented racial/ethnic groups. Surprisingly, the data revealed that even students with a positively stereotyped racial/ethnic and/or gender identity also experienced greater anxiety when they were concerned about mathematics stereotypes. This finding suggests that students with a positively stereotyped identity may experience burden of proof – a concern about performing well to meet others' expectations— which may increase their mathematics anxiety.

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### References

- <sup>1</sup> [Steele & Aronson, 1995; Spencer, Steele, & Quinn, 1999](#)
- <sup>2</sup> [Ahlqvist, London, & Rosenthal, 2013; London, Downey, Romero-Canyas, Rattan, & Tyson, 2002; Mendoza-Denton, Downey, Purdie, Davis, & Pietrzak, 2002; Woodcock, Hernandez, Estrada, & Schultz, 2012](#)
- <sup>3</sup> [Lee, 2012; Seo, Shen, & Alfaró, 2019](#)
- <sup>4</sup> [United States Census Bureau, 2018](#)
- <sup>5</sup> [Nguyen & Ryan, 2008](#)
- <sup>6</sup> [Brown & Josephs, 1999](#)
- <sup>7</sup> [Jamieson & Harkins, 2012](#)

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