

Looking Within: Exploring Gender and Socioeconomic Differences in Black/African American Students' Mathematics Mindsets and Experiences

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Introduction

As the STEM sector has continued to expand, so has the demand for a diverse workforce to advance technology and create innovative products and companies to meet global needs (Noonan, 2017). Despite some efforts to recruit Black/African American

students to pursue degrees and careers in STEM, they continue to make up a lower proportion of STEM graduates relative to their proportion in the adult population. For example, in 2018, when Black/African Americans comprised approximately 14% of the U.S. population, they represented only 9% of the total science and engineering degrees awarded and less than 10% of scientists and engineers who were employed full-time (NCSES, 2021).

Educators and researchers highlight the important role math and science courses play in students' persistence in STEM majors and their pursuit of STEM careers. Research indicates that course-taking differences before college may contribute to the historical underrepresentation of some racial/ethnic minority groups in STEM fields (NCSES, 2021).

Additionally, students' experiences in math impact their outcomes and persistence in STEM. For Black/African American students specifically, research has found that factors such as racialized classroom experiences, teacher biases, lower academic expectations, tracking policies, and access to high-quality math instructors and curriculum have affected their sustained academic engagement with math during their K-12 educational experience (Diemer et al., 2016; Gonzalez et al., 2020; Rogers, 2020). Research has also found that students' beliefs about math and their math ability impact their math performance. Specifically, students with a growth mindset (the belief that intelligence is malleable) tend to outperform those with a fixed mindset (the belief that intelligence is fixed and cannot be changed; Hwang et al., 2016).

One potential lever to support Black/African American students' participation in STEM is understanding the nuances of their experiences with mathematics in K-12 classrooms. Such research can provide educators and decision-makers with best practices promoting Black/African American student participation in math. To this end, this study seeks to understand Black/African American students' (ages 10-17) experiences studying math and the factors that may influence their math course-taking and achievement. We studied the responses of students ages 10-17 to survey questions about the following factors:

- Classroom climate (teacher and peer interactions in math class),
- Math identities and beliefs about math (students' views of their math ability, how math ability develops, and the importance of studying math),
- Support from parents around math learning (parental expectations and providing help), and
- Instructional Practices (classroom instructional practices and students' perceptions of the usefulness of these practices).

Findings

This analysis is part of a more extensive study NORC conducted to explore how students view math (math mindset), their math abilities (math identity), and their experiences studying math (instructional contexts). The data were collected through a survey of a nationally representative sample of students ages 10-17 administered in the spring of 2023. The study also surveyed the parents of students ages 10-17 on topics like those included in the student survey.

An equity centered approach. This research brief is guided by scholarly work that calls for equity research efforts towards STEM reform to look beyond student outcomes and the use alternative research approaches to avoid the “gap-gazing” phenomenon (Rodriguez, 2001; Gutierrez, 2008). Gap gazing may occur when students from different race/ethnicity groups are compared absent of any discussion about why disparities exist. This approach can inadvertently promote the belief that marginalized students have inherent shortcomings and other misleading ideas about academic achievement. Instead, this research brief presents the results of a descriptive subgroup analysis focusing solely on data collected from Black/African American youth. Using this approach enables us to understand the within-group nuances of Black students’ experiences with factors empirically linked to student participation in math (Volpe et al., 2022; Gonzalez et al., 2020).

For this study, students identifying as Black/African American were oversampled due to a particular interest in the experiences of subgroups who are underrepresented in honors and advanced placement (AP) coursework (Flowers, 2008) and in STEM majors and careers (NCSES, 2021). The final subsample containing 230 Black/African American students was balanced by gender (48% female). It comprised primarily of students in grades 9 through 12 (67%) and was socioeconomically diverse. To facilitate comparisons, we classified the sample into four socioeconomic groups based on differences in family educational backgrounds and financial resources (see Table 1).

Table 1. Black/African American Students’ Socioeconomic Status (SES) Groups

SES Group	Frequency/ Number	Percentage
Low	66	29
Lower-Middle	74	32
Upper-Middle	52	22
High	37	16
<i>Total</i>	<i>230</i>	<i>100%</i>

The survey instrument included several items related to instructional practices and student motivation. It was also designed to be relevant to both youth (ages 9 – 12) and teen respondents (ages 13-17).

Participants completed a 65-question survey, responding to most items on a six-point Likert scale (Strongly Disagree to Strongly Agree). For this brief, we collapsed responses into three categories representing different degrees of agreement (Table 2).

Table 2. Degrees of Agreement

Degree of Agreement	Survey Response Options
Low/negative	Strongly Disagree/Disagree
Moderate	Somewhat Disagree/Somewhat Agree
High	Agree/Strongly Agree

We tabulated the responses to each survey question and conducted descriptive analysis by gender and SES group. Below is a summary of our findings.

Findings by Gender

Based on prior research that suggests that male and female students have different experiences studying math (Jacobs, 2005), we expected to observe differences in male and female experiences studying math. Instead, we found little difference in students' experiences studying math by gender. Out of 65 questions, Black/African American female and male students only responded differently on three items (see Table 3). Otherwise, we found that Black/African American female and male students responded similarly to almost all the questions about their math identity and beliefs, classroom experiences, and parental support.

Table 3. Black/African American Student Responses to Survey Questions About Parental Support, Classroom Support, and Their Math Ability by Gender

Survey Questions about Math Experiences	Gender	Percentage Agreement (%) of Students		
		Low	Moderate	High
<i>My parent(s) help me to decide which math classes to take. *</i>	Male	25%	29%	47%
	Female	15%	43%	42%
<i>When math is hard, I can get help from my classmates.</i>	Male	20%	40%	40%
	Female	12%	45%	43%
<i>I understand math even when it is hard</i>	Male	24%	41%	35%
	Female	15%	53%	32%

*Note: Differences in percent of high degree of agreement are significant at $p < 0.05$

These findings suggest that Black/African American male and female students in our sample hold similar beliefs about math and their math ability and report similar experiences learning math and receiving parental support.

Findings by Socioeconomic Status

Based on prior research that highlights socio-economic disparities in students' access to resources and quality instruction when studying math (Strayhorn, 2010), we analyzed Black/African American student responses by socioeconomic status (SES). While many students' responses were the same across SES groups, we observed differences for questions related to students' beliefs about math ability, specifically items related to growth versus fixed mindset.

Black/African American students across SES groups did not generally endorse fixed mindset statements such as *"I can't change how good I am at math"* and *"Even if I do all my work, I may not become good at math."* Further, when we looked at Black/African American student responses to these items by SES, we found that students in the two highest SES groups agreed with the fixed mindset statements less often than Black/African American students in the two lowest SES groups (see Table 4). This aligns with existing research that found that students from lower SES backgrounds tend to hold stronger fixed mindsets than those from higher SES backgrounds (Claro, 2016; Destin et al., 2019).

Additionally, Black/African American students across SES groups generally agreed or strongly agreed with statements reflecting a growth mindset, like *"I can be good at math if I work hard at it."* Interestingly, fewer Black/African American students in the highest SES group agreed (62%) with the growth mindset statements compared to the three other SES groups (70-71%). These findings also align with existing research on the relationship between mindset and SES, finding that higher SES students are more likely to view "math intelligence" as a fixed trait (Hwang et al., 2019).

Lastly, most Black/African American students in our sample (78%) highly endorsed the belief that "Some students are naturally good at math." Interestingly, despite a generally high level of agreement, the statement garnered the most agreement from Black/African American students in the Upper Middle SES group, with 87% agreeing. In comparison, those in the High SES group showed the lowest level of agreement at 71%.

Table 4. Percentage of Black/African American Students Who Responded Most Favorably to Survey Questions About Math Ability by SES Group

Survey Questions about Math Ability	Percentage (%) of Students with High Degree of Agreement			
	Low SES	Lower Middle SES	Upper Middle SES	High SES

I can't change how good I am at math. *	32%	23%	10%	14%
Even if I do all my work, I may not become good at math.	28%	25%	12%	13%
I can be good at math if I work hard at it.	70%	71%	71%	62%
Some students are naturally good at math.	79%	75%	87%	71%

*Note: Differences in percent high degree of agreement are significant at $p < 0.05$

These findings reflect existing research exploring the relationship between SES, growth mindset, and student achievement. While some research cites a positive association between growth mindsets and SES (Claro, 2016; Destin et al., 2019), others have found the opposite association (Hwang et al., 2019). Regardless of the direction of the pattern, this study supports existing research that suggests an interesting and important relationship between students' mindset and their socio-economic background warrants further study.

Exploring Parent Mindsets about Math Ability by SES

Students' mindsets about their ability and intelligence are influenced by their parents' and teachers' beliefs and behaviors related to those beliefs (Haimovitz & Dweck, 2016). We analyzed parents' responses to questions about their child's math ability, in general, and by SES groups, to identify any commonalities in Black/African American students and Black/African American parents' beliefs.

Like Black/African American students, we found that across SES groups, Black/African American parents' endorsed growth mindsets such that more parents agreed with statements related to growth mindset and fewer with statements related to fixed mindset items. For example, 77% of Black/African American parents in our sample agreed with the statement, "If my child works hard, they can do well in math class." For this item, there were no differences in parents' responses by SES. Table 5 displays the percentage of parents who responded with high agreement to each mindset item by SES group.

Even with the overall low endorsement of a fixed mindset, more Black/African American parents in the two lowest SES groups than parents in the two highest SES groups agreed with the statement, "*My child was born with a certain degree of math ability and not much can be done to change it*". Similarly, fewer Black/African American parents in the highest SES group than in the other SES groups agreed that: "*Even if my child does all their work, they may not become good at math.*" These findings suggest that Black/African American parents' beliefs about math ability differ by SES in similar ways to the patterns we

observed for Black/African American students in our sample.

Unlike Black/African American students in our sample, however, across SES groups, many Black/African American parents in our sample agreed with the statement, “Some students are naturally good at math.”

Table 5. Percentage of Black/African American Parents Who Responded Most Favorably to Survey Questions About Math Ability by SES Group

Survey Questions about Math Ability	Percentage (%) of Parents with High Degree of Agreement			
	Low SES	Lower Middle SES	Upper Middle SES	High SES
My child was born with a certain degree of math ability, and not much can be done to change it.*	31%	38%	17%	25%
If my child works hard, they can do well in math class.	75%	80%	79%	78%
Even if my child does all their work, they may not become good at math.	27%	25%	26%	16%
Some students are naturally good at math.	73%	77%	71%	75%

*Note: Differences in percent high degree of agreement are significant at $p < 0.05$

Like Black/African American students in our sample, Black/African American parents tended to endorse a growth mindset overall. However, the findings also suggest that adult math mindsets differ by SES in ways like those we observed among Black/African American students.

Conclusion

This study aimed to examine the nuances in Black/African American students' experiences studying math by asking them about important factors (mindset, beliefs, and instructional contexts) that influence their performance and persistence in math and STEM. We observed few gender differences in Black/African American students' responses to questions about math beliefs, mindsets, and experiences. This suggests that more research may be needed outside of the areas we studied to understand gender differences observed in student performance in the existing research literature.

While we did not find many differences in Black/African American students' experiences learning math by SES (i.e., their instructional experiences and

beliefs), we did find differences in Black/African American students' beliefs about the malleability of their math ability and math ability more generally by SES. Black/African American students generally endorsed a growth mindset but there were important differences in their level of agreement by SES. For example, Black/African American students in the highest SES group endorsed growth and fixed mindset beliefs less frequently than their peers in the lower SES groups. This finding aligns with existing research citing a significant and important relationship between a growth mindset and SES (Claro, 2016; Destin et al., 2019; Hwang et al., 2019). It also reflects the complexities in existing research about the direction of the association between mindset and SES (i.e., whether the two are positively or negatively associated).

One explanation for the controversy about mindset is that there are contextual factors to consider about why SES and mindset are linked. In their review of research examining the relationship between mindset and outcomes, Yeager and Dweck (2020) confirmed that ample evidence suggests the relationship exists. However, they also acknowledge that additional factors (e.g., the degree to which individuals struggle academically or between and within cultural differences) may impact the strength of the relationship. Similarly, in our data, we might expect unexplained differences within and between SES groups that may play a role in how Black/African American students think about their math ability.

Black/African American parents in our sample also responded differently to items about the malleability of math ability by SES group. Across SES groups, Black/African American parents highly endorsed growth mindsets and less frequently endorsed fixed mindsets. However, parents in the two lowest SES groups endorsed fixed mindsets more than those in the two highest SES groups. These findings are consistent with existing research exploring the relationship between adults' growth mindsets and socio-economic status. While our analysis was not able to capture these potential differences, it does tell a compelling story that: (1) overall, Black student (and their parents), tend to have high-growth mindsets, and, (2) the strength of these mindsets differs by SES.

These findings reiterate the need for research that continues to explore Black/African American students' math mindsets, especially given the relationship between a positive math mindset and positive outcomes such as math motivation, persistence in math, and math achievement (Dabrowski & Marshall, 2018; Degol et al., 2018). The similarities we found among Black/African American parents and students also suggest the need for more dyadic research to understand the relationship between parent and child mindsets.

One limitation of our study is that we cannot directly speak to the degree to which schools directly influence this mindset. However, the fact that we observed similar responses by SES for Black/African American students and parents suggests that schools and classrooms may not be a buffer against the persistence of these mindsets over time. More dyadic research is needed to understand the relationship between parent and child mindsets and to explore how school contexts and instructional practices might work to interrupt the persistence of fixed mindset beliefs and support growth mindsets.

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