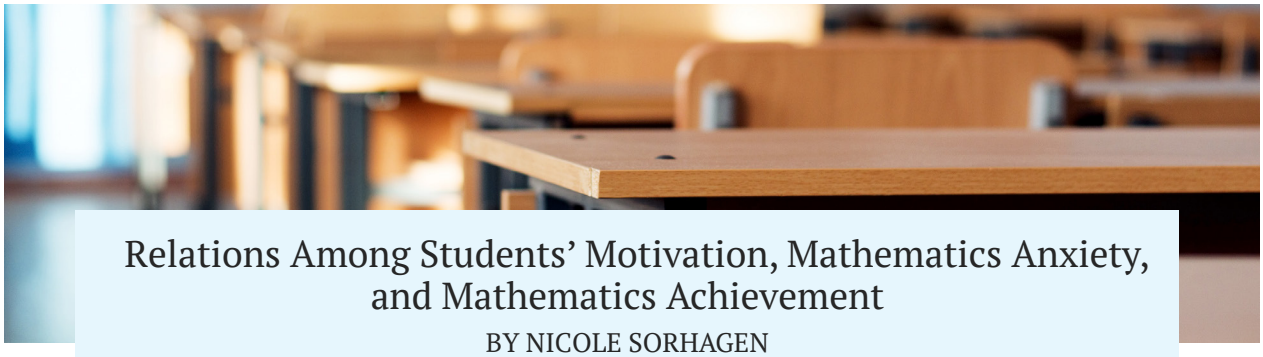

Relations Among Students' Motivation, Mathematics Anxiety, and Mathematics Achievement

BY NICOLE SORHAGEN

Research snapshot | Fall 2019

Mathematics anxiety is defined as feelings of tension or worrying thoughts in situations that involve mathematics. There is little research on the relationship between mathematics anxiety and beliefs about the malleability of intelligence, especially among high school students. However, theory suggests that beliefs about the malleability of intelligence (i.e. growth mindset) could impact mathematics anxiety. Students who believe that ability is malleable tend to have learning goals, which are related to positive affect (i.e. feelings and emotion) and challenge seeking.[1–3] Students who think of ability as fixed, on the other hand, tend to have performance goals, which are related to negative affect and challenge avoidance.[1-3] Because negative emotions and avoidance can also be manifestations of mathematics anxiety,[4] the researchers pursued an exploratory analysis to investigate whether the growth mindset program influenced mathematics anxiety.

Moreover, the researchers tested how the relationship between mathematics anxiety and mathematics achievement differed depending on participation in the program and students' mathematics interest. In much of the mathematics anxiety literature, the effect of anxiety on performance is thought to be linear with higher levels of anxiety predicting lower achievement.[5] However, others have found the relation between anxiety and performance to be more complex. Researchers in cognitive and behavioral fields, for example, often demonstrate an inverted-U shaped relationship, suggesting that a moderate amount of anxiety or stress benefits focus and performance, resulting in "optimal arousal".[6] This inverted-U shaped relation has emerged when students report high mathematics value and interest; the relation was negatively linear when students reported low mathematics value and interest.[7] The researchers were interested in exploring this relationship in the current sample and seeing whether growth mindset played a role in the relationship.

Key Findings

- The growth mindset program used in the National Study of Learning Mindsets appeared to have no effect on students' mathematics anxiety.
- High mathematics anxiety was related to low mathematics grade point average (GPA).

Research Team

- **Early Career Fellow:** Nicole Sorhagen, Millersville University
- Liz Gunderson, Temple University

Areas of expertise: mathematics anxiety, cognitive development, achievement motivation, mathematics cognition, teachers' beliefs and expectations

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 9th grade students during the 2015-2016 academic year. The NSLM features a nationally representative probability sample of regular U.S. public high schools. Additional information about the NSLM sample of schools and students can be accessed here. The analyses reported here included approximately 9,050 high school students.

This snapshot was published at the close of the National Study of Learning Mindsets Early Career Fellowship and captures in-progress work.

MINDSET SCHOLARS NETWORK

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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Study Design

In the National Study of Learning Mindsets (NSLM), students were randomly assigned to complete either the growth mindset program or a control activity during two 25-minute sessions. In the growth mindset program, students read and listened to materials describing scientific evidence about how the brain works and why people can grow their intellectual abilities over time. The program encouraged students to think about why they might want to grow their brain in order to make a difference on something that matters to them, such as their family, community, or a social issue they care about.

Students reported on their mathematics anxiety before and after the growth mindset program or control activity (e.g., "How much does the subject of math make you feel nervous, worried, or full of anxiety?"). Before the program, students also reported their interest in mathematics (e.g., "In your opinion, how interesting is the subject of math in high school?"). The researchers also collected data on students' mathematics grades in 8th and 9th grade.

Key Findings

The growth mindset program used in the National Study of Learning Mindsets appeared to have no effect on students' mathematics anxiety.
There was no evidence that the growth mindset program affected students' mathematics anxiety, and no evidence that this finding differed by students' demographic characteristics, their pre-program fixed mindset, or their pre-program mathematics anxiety.

Further research is needed to more deeply explore this result. First, mathematics anxiety was assessed immediately after the second session of the growth mindset program. It may be that the effect of a growth mindset program on mathematics anxiety takes some time to unfold. Second, the program targeted students' beliefs about their purpose for learning, as well as the malleability of their intelligence. It may be that thinking about how learning can make a difference for others increases anxiety.[8] Therefore, it is possible that the growth mindset aspect of the program reduced mathematics anxiety, but the self-transcendent purpose for learning aspect increased anxiety.

High mathematics anxiety was related to low mathematics GPA
The researchers found a negative relation between mathematics anxiety and mathematics GPA, such that high mathematics anxiety was related to low mathematics GPA and low mathematics anxiety was related to high mathematics GPA.

The researchers did not find evidence that the relation between mathematics anxiety and mathematics GPA differed based on the participation in the growth mindset program or students' mathematics interest.

Insights and Future Directions

While the researchers found no evidence that the growth mindset program affected students' mathematics anxiety, the results do indicate that mathematics anxiety is an important variable in students' performance in the subject area. The present results indicate a linear relationship between anxiety and performance in which low levels of mathematics anxiety were related to higher mathematics GPA and vice versa.

As GPA is known to be influenced by school level factors (e.g. grading norms) and teacher level factors (e.g. biases, grading policies), future research may be warranted to test the relation between students' mathematics anxiety and more discrete outcomes like their mathematics-related test performance or their mathematics-related behaviors. Moreover, mathematics-related performance and behavior may be more likely to have an inverted-U shaped relation with mathematics anxiety than GPA. If some students, perhaps based on their interest in the subject or their beliefs about intelligence, interpret moderate amounts of anxiety in different ways, then single tests or short-term behaviors may be more affected than GPA, which is cumulative over time.

References

[1] Blackwell, Trzesniewski, & Dweck, 2007
[2] Burnette, et al., 2013
[3] Elliott & Dweck, 1988
[4] Hembree, 1990
[5] Dowker, Sarkar, & Looi, 2016
[6] Yerkes & Dodson, 1908
[7] Wang, et al., 2015
[8] Yeager et al., 2014

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