

Title: Investigating Math Anxiety and the Gender Gap in Mathematics in the US and Other Countries

Presentation Format: Paper Session

Overview: This study investigates whether math anxiety helps explain gender gaps in mathematics achievement across countries and over time. Using PISA 2012 and 2022 data from the United States and 65 economies, multilevel and path analyses show math anxiety substantially mediates gender differences, often eliminating achievement gaps in international contexts globally.

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Paper Abstract (800 words)

Introduction

Scholars have posited various causes to explain the persistent gap in math achievement between boys and girls, from (among others) biology to societal expectations. If biology is responsible for the differences in math achievement, why is that such gender gap is unsettlingly wide in some countries/economies and almost non-existent (or even reversed) in others? If societal expectation alone is responsible for the divergent math outcomes between boys and girls, why is such a gap present in more than 37 out of 65 countries and economies surveyed? Could other factors help in explaining such gender disparity in mathematics in the US and other parts of the globe?

The present study adds to the current literature by examining the role of math anxiety to explain the existing gap in math achievement between boys and girls in the US and other parts of the world. By utilizing a large international dataset, the current study will provide an invaluable opportunity to assess the role math anxiety plays in the divergent math outcomes of boys and girls internationally and in the US, in particular.

Research Objectives

The objectives of the study are as follows:

- To gain a greater awareness of the role of math anxiety on explaining why boys and girls differ in their math achievement in the US and other parts of the world.

- To better understand how differences in math anxiety is associated with differences in math outcomes between boys and girls internationally and in the US, in particular.
- To assess the varying effects of math anxiety on male and female performance in mathematics in the US and around the globe.
- To compare results from PISA-Math 2012 with those from PISA-Math 2022

Methodology

The study utilized data from the Program for International Student Assessment (PISA) study, an international assessment that measures 15-year-old students' reading, mathematics, and science literacy. Approximately 510,000 students between the ages of 15 years 3 months and 16 years 2 months participated the study, representing about 28 million students globally. First conducted in 2000, the PISA study is conducted every three years, and the major area of study rotates between reading, mathematics, and science per cycle. PISA 2012's focus was on mathematics, and PISA 2022's focus was again on mathematics.

The data were analyzed using descriptive statistics, path analyses, and hierarchical linear modelling (HLM). The independent variables included gender, math anxiety, and the differences in math anxiety between boys and girls. The dependent variable was math outcomes and the differences in math outcomes between male and female students. The multilevel analysis were assessed at the student, school, and country levels.

Results

When examining the effects of potential mathematics anxiety on gendered outcomes in the US, three multilevel regression models were created and conducted for both the US data and the international data. For the US data, Model 1 indicated when only investigating gender as a sole factor, it seemed gender was significant ($t = 106.78$, $p < .001$) on mathematics achievement outcomes. Model 2 indicated when considering mathematics anxiety in the model, gender was no longer a significant predictor ($t = 1.37$, $p > .05$), while mathematics anxiety was a significant predictor ($t = -13.97$, $p < .001$). Model 3 investigated gender, mathematics anxiety, and their interaction effect in the model, and all of them were significant with gender ($t = 1.10$, $p < .001$), mathematics anxiety ($t = -8.01$, $p < .001$), and the gender*anxiety interaction ($t = -94.90$, $p < .001$). Note both PISA 2012 and PISA 2022 demonstrated similar results for the US data. For the international data (*65 Countries & Regions*), Model 1 showed gender was significant ($t = 540.58$, $p < .001$). Model 2 showed gender was significant ($t = 30.70$, $p < .001$) and mathematics anxiety was significant ($t = -138.35$, $p < .001$). Model 3 showed that gender, mathematics anxiety, and their interaction were all significant ($t = 31.75$, $p < .001$; $t = -118.32$, $p < .001$, and $t = -52.39$, $p < .001$, respectively).

In addition, path analyses showed the significant loadings and relationships between gender, math self-efficacy, math self-concept, math anxiety, and math achievement.

Discussion

Our research finding indicated that in the US and in many parts of the globe, girls showed higher levels of math anxiety than their male counterparts. Interestingly, the effect of math anxiety on

math achievement was greater for boys than girls. Countries and economies with a greater gap in math anxiety between boys and girls also showed greater gender disparity in math achievement. In the US, a model containing gender as the sole predictor showed that boys had significantly better math outcomes than their female counterparts; however, when math anxiety was added to the model, the differences in math outcomes between boys and girls became negligible and statistically insignificant. Practical and theoretical implications will also be discussed.