Math, The Girl That All the Nerds Want: Examining Attitudes and Beliefs by Personifying Mathematics

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Abstract: This concurrent-nested mixed methods study explored mathematics personification to examine students' ($n = 173$) attitudes and beliefs about mathematics. Findings highlight 7 themes of personification: *organized, rigid, useful, engaging, enigmatic, daunting,* and *thoughtful*; and reveal a relationship between *daunting* and math anxiety. A common theme among students who rated themselves as high in math anxiety is that mathematics as a person is *enigmatic*, *daunting*, and *thoughtful*, indicating a greater need for a healing-centered approach to teaching mathematics.

Introduction

Examining the attitudes and beliefs students have about mathematics is important to helping educators better understand students' previous experiences with mathematics and how those experiences have impacted students' mathematics learning. The interpretation theory suggests math anxiety develops from the ways students interpret these math-related experiences (Ramirez, Shaw, Maloney, 2018). In the current work, I ask students to personify mathematics (i.e. "Imagine Math was a person. Describe the kind of person Math would be.") to explore their attitudes and beliefs. The purpose of this concurrent-nested mixed methods study is to explore how mathematics personification can uncover differences between how students with low and high math anxiety describe mathematics. The following research questions guide this study:

> *Qualitative Research Question 1: How do undergraduate personify mathematics?*
>
> *Mixed Methods Research Question 2: Is there a relationship between student personification of mathematics and math anxiety, and how do students with high math anxiety and low math anxiety personify mathematics?*

Conceptual framework

Like the Draw a Scientist Test, which seeks to understand stereotypical perceptions of scientists (Finson 2002; Knight & Cunningham, 2004), asking students to personify mathematics provides insight into their implicit attitudes and beliefs about mathematics. People use personification to make sense of the world, aid their efficiency in learning unfamiliar concepts, and satisfy their basic need for social relationships (Guthrie, 1995). Teachers and students use personification to explain the nature of matter in science classes (Taber & Watts, 1996). Thus, personification of mathematics provides us a way of understanding how students make sense of what is mathematics.

Methodology

The quantitative and qualitative data was collected simultaneously (Plano Clark & Creswell, 2008, p. 184 – 185). Undergraduate students ($n = 173;\ \text{female} = 143; \text{male} = 29; \text{decline to state} = 1$) were asked to fill out a survey prior to beginning an introductory statistics course. The survey included questions on demographic information such as sex, race, and year of school at the university, as well as measures for mathematics personification and math anxiety. Themes (see Table 1) were created using participants' own responses to the personification prompt using a grounded theory approach (Strauss & Corbin, 1998). These responses were then transformed into dichotomous variables to conduct a one-way between-subjects analysis of variance to answer the second research question. Data analysis for the second research question allowed for the integration of both the qualitative and quantitative data by examining the relationship of each theme with mathematics anxiety.

Results

Of the 173 responses analyzed, 152 (87.9%) responses did not assign a gender to mathematics. Although there were similar themes across varying levels of math anxiety, the lexical choices of the students with high math anxiety (HMA) differed from the low math anxious (LMA) students. When students personified mathematics as *organized*, students with HMA described it as being "emotionless and cold", and "struggling with creativity." Students with LMA described math as a "straight-forward person", "friendly", and "unexpectedly fun." Additionally, when students described mathematics as *engaging*, students with HMA described it as being an

"introvert", "the girl that all the nerds want" (the title of this paper), and "like a drug". Students with LMA described math as "a knowledgeable old man". *Daunting* was the only theme for which students with HMA and LMA could not be compared; these students described mathematics as "a awful horrible, conniving person", "imposing figure with a face full of darkness," Satan, "my arch nemesis", and "a smart murderer".

Table 1: *Definition of Personification categories*

Category	Definition
Organized	Someone who is deliberately efficient and detail oriented. They think objectively and logically, and they are methodical and systematic.
Rigid	Someone who follows the rules and is inflexible. Someone who is emotionless and dull. They only see things in one way.
Useful	Someone who is helpful and solution driven. They are reliable and determined to find the correct answer.
Engaging	Someone who causes great surprise and sudden wonder. They are attractive and enchanting.
Enigmatic	Someone who is hard to figure out. They are complicated and confusing. They can be difficult to understand.
Daunting	Someone who is scary and intimidating. They are the source of anxiety and fear.
Thoughtful	Someone who is introspective. They are contemplative and reflective.

Math anxiety did not vary among people who personified mathematics as *organized* $[F(1,171) = 1.547, p = .215]$, *rigid* $[F(1,171) = .008, p = .927]$, *useful* $[F(1,171) = .008, p = .927]$, *engaging* $[F(1,171) = .077, p = .781]$, or *thoughtful* $[F(1,170) = .047, p = .829]$. Math anxiety only varied among students who personified mathematics as *enigmatic* and *daunting.* It is important to note there were no students with LMA who personified mathematics as *daunting*.

Implications

Students may have similar attitudes and beliefs about mathematics, but there may be a difference in how students with HMA and LMA relate to mathematics, supporting the interpretation theory. As such, these results may indicate a greater need for a healing-centered approach to teaching mathematics that would allow students to explore their previous math-related experiences. Future studies should include interviewing participants about their word choices and how their experiences influence those word choices to investigate any important socializers influencing their relationship to mathematics across developmental stages. Furthermore, white supremacy and settler colonialism are important socializers we should also examine as influencing students' relationship to math.

References

Finson, K. D. (2002). Drawing a scientist: What we do and do not know after fifty years of drawings. *School science and mathematics*, *102*(7), 335-345.

Guthrie, S. E., & Guthrie, S. (1993). *Faces in the clouds: A new theory of religion*. Oxford University Press on Demand.

Knight, M., & Cunningham, C. (2004, June). Draw an engineer test (DAET): Development of a tool to investigate students' ideas about engineers and engineering. In *ASEE Annual Conference and Exposition* (Vol. 2004).

Plano Clark, V. L., & Creswell, J. W. (2008). *The mixed methods reader*. Sage.

Ramirez, G., Shaw, S. T., & Maloney, E. A. (2018). Math anxiety: Past research, promising interventions, and a new interpretation framework. *Educational Psychologist*, 1-20.

Rice, L., Barth, J. M., Guadagno, R. E., Smith, G. P., & McCallum, D. M. (2013). The role of social support in students' perceived abilities and attitudes toward math and science. *Journal of Youth and Adolescence*, *42*(7), 1028-1040.

Strauss, A., & Corbin, J. (1998). Basics of qualitative research: Procedures and techniques for developing grounded theory.

Taber, K. S., & Watts, M. (1996). The secret life of the chemical bond: Students' anthropomorphic and animistic references to bonding. *International Journal of Science Education, 18*(5), 557-568.

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