



Examining Gender Differences in Children's Math Identity and Representations of Mathematicians Across Elementary Grades



Jisun Kim¹, Caroline Byrd Hornburg¹, Tamika L. McElveen², Gillian E. Grose³, Christine A. Berry¹, Gabrielle C. Elardo¹, Caroline V. Begley¹, Amanda S. Mayes², Dana Miller-Cotto⁴, Ma Bernadette Andres-Salgarino⁵, Sarah R. Powell⁶, Sara A. Schmitt⁷, David J. Purpura²

¹Virginia Tech, ²Purdue University, ³University of Maryland, College Park, ⁴Kent State University, ⁵Santa Clara County Office of Education, ⁶The University of Texas at Austin, ⁷University of Oregon

Introduction

- Middle school students' drawings of mathematicians reflect a gender-related bias, which is important given that these representations can be related to consideration of future careers (Picker & Berry, 2000; Rock & Shaw, 2000).
- Research also supports using math identity as a tool for understanding continued participation in math (Boaler & Greeno, 2000), considering the underrepresentation of women in Science, Technology, Engineering and Mathematics (STEM) fields (Hill et al., 2010).
- The current study aimed to examine gender differences in elementary students' (3rd-5th grades) representations of mathematicians in terms of their drawings' a) gender and b) emotional valence. Furthermore, we examined gender and grade differences in children's math identity.

Method

Participants: 234 3rd-5th grade children (101 3rd graders, 103 4th graders; 30 5th graders; 130 girls and 104 boys; 39% White, 31% Latine, 15% Multiracial, 10% Black, and 5% Other race/ethnicity) and their parents (78% having below an Associate's Degree). Two samples of data were collected, one in Fall 2021 and one in Spring 2022, in both the Midwestern and Western U.S., as part of a larger study. The same measures were collected and samples were combined for the present analysis (with no differences between cohorts).

Procedure:

- **Draw a Mathematician Task (adapted from Picker and Berry [2000])**
 - Children were asked to draw a mathematician and describe their drawings
- **Child Math Identity (adapted from Cribbs et al., [2015])**
 - Children completed a 12-item math identity survey (see items in Table 2)
- **Coding for Drawings**
 - The **gender** of drawings was coded from gendered pronouns in their descriptions or features in the drawing (e.g., hair length), if present
 - **Emotional valence** was coded from drawings and descriptions in terms of showing clearly positive, neutral, clearly negative, mixed emotions, or unrecognizable emotions
- **Demographic Survey**
 - Parents reported child gender, race/ethnicity, and parent education for primary and secondary caregivers

Example Drawings of Mathematicians



Table 1
Percentage of Children Who Drew Female Mathematicians by Grade and Gender

	Third Grade	Fourth Grade	Fifth Grade
Boys	6/23 = 26.1%	4/22 = 18.2%	6/8 = 75.0%
Girls	40/43 = 93.0%	43/50 = 86.0%	10/12 = 83.3%

Note. N = 158, including only drawings that were coded as gendered figures.

Results

- Across grades, girls had a higher proportion of drawings that were coded as either male or female (vs. a non-gendered figure) than boys (81% vs. 51%, $p < .001$), while providing more gender-salient descriptions (51% vs. 34%, $p = .01$).
- Girls were more likely to draw female mathematicians than were boys (89% vs. 30%, $p < .001$, see Table 1).
- Most drawings/descriptions (57%) included clearly positive emotions, 38% were neutral, 2% included clearly negative emotions, and 3% included mixed/non-codable emotions.
- More girls' drawings included positive emotions compared to boys' (69% vs. 46%, $p < .001$).
- Gender differences were found for some items in the recognition factor of math identity (see Table 2). In particular, the reference person mattered.
- "My math teacher sees me as a math person" responses for all children were higher than other "math person" item responses, $p < .001$.
- However, for parents' beliefs, boys' responses were higher than girls' ($p = .03$).
- For "I see myself as a math person," girls' responses were lower than boys' at older grades, though this was not statistically significant.

Table 2
Children's Average Responses to Math Identity Survey Items by Grade and Gender

Item	Third Grade		Fourth Grade		Fifth Grade		
	Boys (n = 42)	Girls (n = 42)	Boys (n = 36)	Girls (n = 50)	Boys (n = 13)	Girls (n = 14)	
1	I see myself as a math person.	3.10	3.19	2.94	2.78	3.00	2.43
2	My parents/caregivers/guardians see me as a math person.	3.19	3.07	3.47	2.96	3.54	3.14
3	My relatives/family members see me as a math person.	3.19	3.07	3.19	2.88	3.38	2.79
4	My friends see me as a math person.	3.17	2.86	3.03	2.80	2.62	2.50
5	My math teacher sees me as a math person.	3.67	3.57	3.36	3.52	3.54	3.21
6 ^a	I see myself as a mathematician.	3.29	3.10	2.78	2.88	2.62	2.07
	<i>Recognition Factor</i>	3.27	3.14	3.13	2.97	3.11	2.69
7	I am confident that I can understand math.	3.17	3.33	3.39	3.22	3.46	3.29
8	I am confident that I can understand math when I am doing homework by myself.	3.52	3.48	3.53	3.30	3.23	2.93
9	I am confident that I can understand math when I can't ask the teacher for help.	3.10	3.12	3.44	3.26	3.54	2.86
10	I am confident that I can understand math when I am solving real-world problems on my own.	3.29	3.24	3.25	2.96	3.31	2.57
11	Others ask me for help in math.	3.14	3.19	2.94	2.96	2.54	3.00
12	I can overcome challenges in math.	3.12	3.02	3.25	3.10	3.31	3.14
	<i>Competence Factor</i>	3.22	3.23	3.30	3.13	3.23	2.96

Note. N = 197, including only participants with complete data for all items. The scale for each item ranged from 1 to 4 (1 = No, 2 = Not Really, 3 = Kind of, 4 = Yes). Items 1-6 form a recognition subscale of math identity, whereas items 7-12 form a competence subscale of math identity. ^aItem 6 was administered last in the scale (new item) but is listed with its subscale.

Discussion

- Girls' drawings revealed higher proportions of female mathematicians and more positive emotions. However, girls' beliefs about themselves and their perceptions of parents' beliefs of them as a "math person" were not as positive.
- Findings highlight the need for teachers and parents to support all children's positive math identity, to encourage internal beliefs that they are capable math learners.
- More research with larger samples is needed. Future studies could assess children's drawings of mathematicians and math identity at multiple time points, to examine patterns of change over time and in the transition to middle school.

References

1. Boaler, J., & Greeno, J. G. (2000). Identity, agency and knowing in mathematics worlds. In J. Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 171-200). Ablex Publishing.
2. Cribbs, J. D., Hazari, Z., Sonnert, G., & Sadler, P. M. (2015). Establishing an explanatory model for mathematics identity. *Child Development, 86*(4), 1048-1062. <https://doi.org/10.1111/cdev.12363>
3. Hill, H. C. (2010). The nature and predictors of elementary teachers' mathematical knowledge for teaching. *Journal for Research in Mathematics Education, 41*(5), 513-545.
4. Picker, S. H., & Berry, J. S. (2000). Investigating pupils' images of mathematicians. *Educational Studies in Mathematics, 43*, 65-94.
5. Rock, D., & Shaw, J. M. (2000). Exploring children's thinking about mathematicians and their work. *Teaching Children Mathematics, 6*(9), 550-555.

Acknowledgments

Thanks to participating students, parents, and school staff. The research reported here was supported by the EF+Math Program of the Advanced Education Research and Development Fund (AERDF) through funds provided to Purdue University. The opinions expressed are those of the authors and do not represent views of the EF+Math Program or AERDF.