Gender Differences in Mathematics and its Cognitive and Non-Cognitive Predictors in Community College Students

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Introduction

Historically, numerous studies have supported a male advantage in math. While more recent literature has shown that the gender gap is either decreasing or non-significant, a gender difference remains for higher level math (high school and college) (Hyde et. al. 1990; Casey et. al. 1995). It is also known that both cognitive and non-cognitive factors influence math performance.

There is little evidence for gender differences in working memory (Miller & Bichsel, 2004), which is a key predictor for mathematics. There is, however, evidence for gender differences in the non-cognitive domain, including math anxiety, with females having higher levels (Miller & Bichsel, 2004; Goetz, et. al. 2013). This study evaluates gender differences in both standardized and everyday math performances, and the way that cognitive and non-cognitive factors impact math.

The study is focused on a very understudied group with high levels of math difficulty, namely community college students. We expected to find gender differences in math and expect these to be in part accounted for by gender differences in strong mathematical predictors, particularly non-cognitive factors.

Participants/Procedures

Participants included 94 community college students enrolled in their first math class (60 female; 34 male).

Participants were administered the Kaufman Test of Educational Achievement – 3rd edition (KTEA3): Math Computation (MC) and Math Concepts Application (MCA) subtests, as well as an original Everyday Math (EM) measure which assessed their math ability in the context of common uses for math (e.g., financial and health numeracy). Additional measures included math anxiety, self-efficacy, and confidence. Finally, complex span working memory tasks were administered to assess verbal and spatial working memory.

Analyses were performed using correlation and regression to examine relationships between the cognitive and non-cognitive variables and standardized and everyday math measures.

**Note for Table 1. Demographics: Race = % Caucasian regardless of Hispanic Status. Ethnicity = % Hispanic regardless of Race*

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Table 1. Demographics

	N	Age (Mean (SD))	Race (% Caucasian)	Ethnicity (% Hispanic)
Male	34	20.85 (2.03)	32.35%	52.94%
Female	60	20.40 (2.17)	33.33%	31.67%

Table 2. Measures

1. KTEA-3 Math Computation	Kauffman Test of Educational Achievement 3rd Edition – Math Computation
2. KTEA-3 Math Concepts Application	Kauffman Test of Educational Achievement 3rd Edition – Math Concepts Application
3. Everyday Math (EM)	Math measure that assesses student's math ability for common uses (finances, health literacy, etc.)
4. Math Anxiety	AMAS – The Abbreviated Math Anxiety Scale
5. Self-Efficacy	MSES – Math Self-Efficacy Scale
6. Confidence	MSLQ - Motivated Strategies for Learning Questionnaire
7. Verbal Working Memory	Reading Span: Memory
8. Spatial Working Memory	Symmetry Span: Memory

Table 3. Correlations of Measures

	1	2	3	4	5	6	7
1. KTEA-3 Math Computation	-						
2. KTEA-3 Math Concepts Application	.79**	-					
3. Everyday Math (EM)	.79**	.82**	-				
4. Math Anxiety	-.37**	-.26*	-.25*	-			
5. Self-Efficacy	.25*	.34**	.32**	-.24*	-		
6. Confidence	.22*	.22*	.20	-.41**	.36**	-	
7. Verbal Working Memory	.27*	.41**	.39**	.01	.30**	.25*	-
8. Spatial Working Memory	.23*	.39**	.30**	-.17	.23*	.21*	.26*

Note for table 3. *p < .05. **p < .01

Results

Correlations showed that all cognitive and non-cognitive variables are significantly correlated with all three math measures (all $p < .05$). There were no significant gender differences for any of the math measures, nor the working memory, or non-cognitive measures.

Regression showed that across all three math outcomes, math anxiety and verbal working memory are significantly predictive of math performance. Overall R^2 values were significant (range 27% to 37%, all $p < .001$).

Working memory and math anxiety were unique predictors in all three regressions (all $p < .05$), but other non-cognitive variables such as self-efficacy did not show unique prediction (all $p > .05$).

Discussion

There was no evidence for gender differences on any studied variable. This stands in contrast to prior studies, although few studies have included community college students.

On the other hand, both cognitive and non-cognitive factors were complimentary in the prediction of math outcomes, which is consistent with prior work. Both working memory and math anxiety uniquely predicted math outcomes, and among non-cognitive predictors, math anxiety was particularly prominent.

This study clarifies prior conflicting work regarding gender differences and highlights the role of both math anxiety and working memory as relevant for multiple math outcomes.

Future Directions

Data collection is ongoing for this sample of community college students. A more in-depth examination of the unique influence of the cognitive and non-cognitive factors on math outcomes will be conducted.

Key References

Miller, H., & Bichsel, J. (2004). Anxiety, working memory, gender, and math performance. *Personality and Individual Differences*, *37*(3), 591-606.

Hyde, J. S., Fennema, E., & Lamon, S. J. (1990). Gender differences in mathematics performance: a meta-analysis. *Psychological bulletin*, *107*(2), 139.

Goetz, T., Bieg, M., Lüdtke, O., Pekrun, R., & Hall, N. C. (2013). Do Girls Really Experience More Anxiety in Mathematics? *Psychological Science*, *24*(10), 2079–2087.