



Creativity and Grit as Predictors of Mathematics Achievement in Early Adolescence

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Introduction

- Successful mathematical thinkers need more than rote knowledge and memorization; they must also possess the *creative* and *practical* skills necessary to solve real world problems (Schommer-Aikins et al., 2005; Sternberg, 2007).
- The theoretical framework of triarchic thinking/successful intelligence positions creative and practical thinking as likely correlates of achievement (Sternberg, 2006, 2009; Sternberg & Rainbow Project, 2006).
 - Investigations of **creativity** in mathematics have typically been explored with gifted students rather than general school populations.
 - Students' passion and perseverance for long-term achievement, or **grit**, represents the practical effort that students put forth to accomplish their goals and has been studied most often with elite students (Duckworth, Peterson, Matthews, & Kelly, 2007).

Purpose

The purpose of this study was to investigate the relationship among early adolescents' creativity (both in general and specific to mathematics), grit, and mathematics achievement—each representing an area of Sternberg's (1984) triarchic model. We also sought to determine whether students' self-reported grit and creativity differed as a function of gender and ethnicity.

Method

Participants

Participants were 2,434 students (49% girls) in Grades 4-8 from three elementary schools and four middle schools in an eastern central U.S. city. School records identified the students as 56% White, 27% Black/African-American, 10% Hispanic/Latino, 3% Asian, and 4% other.

Data Sources

Students completed a survey of mathematics and reading attitudes, which included the measures described below (see Table 1 for additional information).

- General creativity** was assessed with a 14-item scale composed of 8 items based on Sternberg's (2000) conceptualization of general creativity (e.g. "I like to think about my ideas and decide which ones are best. ") and 6 items taken from an existing creativity subscale from Peterson and Seligman's (2001) VIA Strengths Inventory for Kids (e.g. "I always like to do things in different ways.")
- Mathematical creativity** was assessed with 6 items adapted from Renzulli et al. (2009). Sample item: "I enjoy challenging math puzzles, games, or logic problems."
- Grit** assessed students' perceptions of their ability to persevere in spite of obstacles. Ten items were adapted from an existing subscale measure of grit taken from the VIA Strengths Inventory for Kids (Peterson & Seligman, 2001). Sample item: "Once I make a commitment, I keep it."
- Mathematics achievement** was measured in three ways: mathematics report card grade, teacher rating of competence in mathematics, and teacher rating of motivation in mathematics.

Results

Table 1
Means, Standard Deviations, and Reliability for Study Variables

Variable	N	Mean	SD	α	Possible Range	Observed Range
General Creativity	2,438	4.59	.86	.88	1-6	1-6
Mathematical Creativity	2,467	4.38	1.07	.84	1-6	1-6
Grit	2,438	4.62	.88	.86	1-6	1-6
Math Report Card Grade	2,405	83.26	11.96	---	0-100	6-100
Teacher Rating of Competence	2,495	4.37	1.36	---	1-6	1-6
Teacher Rating of Motivation	2,471	4.33	1.50	---	1-6	1-6

Correlations

- We used zero-order correlations to examine bivariate relationships among study variables (see Table 2).
- All variables were significantly, positively related. Grit and creativity were strongly positively related.

Table 2
Zero-Order Correlations Among Study Variables

Variables	1	2	3	4	5
1. General Creativity	--				
2. Math Creativity	.44	--			
3. Grit	.67	.45	--		
4. Math Report Card Grade	.15	.21	.27	--	
5. Teacher Rating of Competence	.12	.25	.15	.49	--
6. Teacher Rating of Motivation	.13	.23	.23	.57	.66

Note. All correlations were significant at $p < .01$ (one-tailed).

Regression Analyses

- Three multiple linear regression models were conducted in which each achievement outcome was regressed on gender, race/ethnicity, grit, general creativity, and mathematical creativity (see Table 3).
- Girls earned higher grades and higher teacher ratings of motivation than did boys.
- General creativity was negatively related to both math report card grades and teacher ratings of motivation.
- Students with higher scores in mathematical creativity, however, were more likely to have higher grades and higher teacher ratings of both competence and motivation.
- Students with higher scores in grit were significantly more likely to have higher grades and higher teacher ratings of competence and motivation.

Table 3

Regression Results for the Prediction of Three Measures of Math Achievement

Variables	MODEL 1 Math Grade	MODEL 2 Teacher Rating of Competence	MODEL 3 Teacher Rating of Motivation
Gender (β)	-.15**	-.02	-.17**
Race/Ethnicity	-.08**	-.05*	-.11**
General Creativity	-.13**	-.04	.19**
Math Creativity	.16**	.24**	.22**
Grit	.28**	.07*	.11
F	55.48**	31.09**	48.83**
Model R ²	.13	.08	.11

Note. β values standardized.
* $p < .05$; ** $p < .001$

Mean Differences

- Factorial ANOVA revealed no difference in gender, ethnicity, or gender by ethnicity interaction with respect to scores in general creativity and grit.
- Math creativity scores did differ by ethnicity. Children identified as Hispanic had lower math creativity scores than both White and Black children.
- Math report card grades differed by gender and ethnicity. Girls had higher math report card grades than boys. Asian students had the highest math report card grades followed by White students, Hispanic students, and Black students.

Conclusion and Implications

- Grit and math creativity are both correlates of mathematics achievement.
- The ability to persevere in spite of obstacles may be a character trait or a skill that can be nurtured through educational intervention.
- Creative problem-based mathematics teaching strategies may engage students at a deeper level and lead to higher math achievement.
- Divergent thinking is often touted as a 21st century skill. However, in schools, divergent thinkers are less likely to be perceived as motivated by their math teachers and receive significantly lower grades. It may be that creative thinkers have a tendency towards nonconformity, which is not rewarded in large public school systems. Future research should empirically address this disconnect between divergent thinking and academic achievement.

References

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