Abstract Title Page
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Title:

The Relation between Parental Involvement and Math Anxiety: Implications for Mathematics Achievement

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Abstract Body

Limit 4 pages single spaced.

Background / Context:

Description of prior research and its intellectual context.

Students living in urban contexts, especially students from lower-income families, minority (races other than White) students, and English language learners, experience decreased mathematics scores across all levels of education (Plantey et al., 2008). These students are more likely to attend high-poverty elementary schools, more likely to drop out of high school, and less likely to earn a college degree (Plantey et al., 2008). Moreover, these students are repeatedly found to under perform on mathematics exams (Hanushek & Rivkin, 2006) and are repeatedly underrepresented in advanced mathematics courses (Attewell & Domina, 2008). These experiences may have dire consequences on the everyday lives of these students, as mathematics skills are essential not only important for school success, but also for career advancement and daily functioning (Commission, 2000). With this in mind, it is essential that methods in which mathematics achievement can be enhanced are thoroughly researched so that academically stigmatized students will be better prepared to meet the demands of our increasingly technological society (Council, 2001).

One promising avenue to further explore is the role of parental involvement, which has a profound effect on children's mathematics achievement (Gonzalez, Wolters, 2006). However, the underlying mechanisms in which parental involvement influences children's mathematics achievement are still unclear (Jeynes, 2007). Math anxiety may be one of these mechanisms. Research suggests that parental involvement reduces math anxiety and that math anxiety reduces mathematics achievement (Geist, 2009). However, no research has examined if math anxiety mediates the relation between parental involvement and mathematics achievement. This research has important implications for understanding factors that influence mathematics achievement in students living in urban contexts.

Purpose / Objective / Research Question / Focus of Study:

Description of the focus of the research.

Previous research served as the platform for this study's research question: 1) Does math anxiety mediate the relation between parental involvement and mathematics achievement? The primary purpose of this study was to examine this mediation model in a sample of at-risk second graders. Due to previous research, the investigators hypothesized that math anxiety would mediate the relation between parental involvement and mathematics achievement. The objective of this study was to achieve a greater understanding of factors that hinder or promote mathematics achievement in at-risk students. Thus, the focus of this study was on the mathematics achievement of second grade students living in urban contexts.

Setting:

Description of the research location.

This study was conducted in two Title 1 elementary schools located in New York City. Data were collected in Wave 1 while participants were in 2nd grade (2009).

Population / Participants / Subjects:
Description of the participants in the study: who, how many, key features, or characteristics.

Seventy-eight second grade children (51% = female) and their parents participated in this study. Fifty-seven percent of these children were African American, 27% Hispanic, 1% White, and 15% were unidentified. Ninety-two percent of the children received either free or reduced lunch. Twenty-five percent of parents were unemployed. Sixty-four percent of mothers and 58% of fathers reported their education as a high school diploma or less.

Intervention / Program / Practice:
Description of the intervention, program, or practice, including details of administration and duration.
For Track 2, this may include the development and validation of a measurement instrument.

This study utilizes an existing data set in order to examine the relation between parental involvement, math anxiety, and mathematics achievement in hopes to identify factors that improve mathematics achievement in students. By examining this relation, findings could enable educational interventions to employ strategies that raise awareness of math anxiety in parents, and moreover, engage parents to successfully combat these hindrances. The goal of these educational interventions should be to increase mathematics achievement in students living in urban contexts.

Research Design:
Description of the research design.

This study was conducted within the context of a longitudinal correlation study. In this study, the focus was on a cross-sectional sample of second grade students.

Data Collection and Analysis:
Description of the methods for collecting and analyzing data.
For Track 2, this may include the use of existing datasets.

Research assistants visited classrooms in late fall to distribute consent packets. Parents returned completed forms and parental involvement surveys to the principal investigator in a sealed envelope. Consent packets were re-distributed bi-weekly to children who did not return consent forms. Data collection with the children occurred between January and March. Research assistants completed an intensive four-hour training workshop on standardized administration, which included demonstrating 100% accuracy during mock administration. Research assistants conducted the assessments in the schools. In addition, a school psychology doctoral student was present during data collection so that questions and coaching occurred when necessary throughout data collection.

Mathematics ability. For algebraic reasoning, the *Key Math-Third Edition* (KeyMath3; Connolly, 2007) was administered. For children in early elementary school, the items assess pre-algebraic concepts and relations. Children have 5-7 minutes to answer number sentences (e.g., six plus some number equals ten. Point to the missing number), describe patterns and functions (e.g., Look at how this pattern is growing, Which shape comes next in this pattern?), and represent mathematical relations, (e.g., Eight equals six plus what number?). The publisher reports reliability of .83 for second graders.

With Story Problems (Jordan & Hanich, 2000, 2003) children solve 15 brief problems involving three story types: change problems (e.g., Tanisha had 5 pennies. Then Tyra gave her 2 more pennies. How many pennies does Tanisha have now?); compare problems (e.g., Chelsea has 7 pennies. Sean has 5 pennies. How many more pennies does Chelsea have than Sean?); and equalize problems (e.g., Rachel has 4 pennies. Katie has 9 pennies. How many more pennies does Rachel need to have as many as Katie?). The experimenter reads them aloud and students have 30 seconds to respond. Coefficient alpha on this sample was .84.

For procedural skills, the *Stanford Diagnostics Mathematics Test-Fourth Edition* (SDMT-4) was administered in a 25 minute group assessment. Here, children answer 20-multiple choice questions in arithmetic notation. The publisher reports Kuder-Richardson Formula 20 reliability of .84 for second graders.

Parental involvement was measured by a researcher-developed survey which incorporated 5 items based loosely on Hoover-Dempsey and Sandler (1995, 1997; Walker et al., 2005) but focused specifically towards mathematics achievement (e.g., I help my child study for math tests at home; I believe my child is good at math). The survey utilized a Likert scale ranging from 1 (disagree strongly) – 6 (strongly agree). Coefficient alpha on this sample was .84. A full list of items are presented in Table 1.

Seven items from a researcher developed scale (i.e., The *Math Anxiety in Young Children Scale*) assessed math anxiety through children's negative reactions and feelings towards math (e.g., I get nervous about making a mistake in math class; When it is time for math my head hurts). These items have a Cronbach's alpha of .81. A full list of items are presented in Table 1 (please insert Table 1 here).

In order to examine if math anxiety mediates the relation between parental involvement and mathematics achievement, a multiple regression analysis was conducted in accordance to the four steps discussed by Baron & Kenny (1986). In step 1, the effect of parental involvement on mathematics achievement was assessed. This step establishes that there is an effect that may be mediated. In step 2, parental involvement served as the predictor and math anxiety served as the dependent variable. In step 3, math anxiety served as the predictor variable with mathematics achievement served as the dependent variable. Lastly, in step 4, the effect of parental involvement on mathematics achievement was measured after controlling for math anxiety. According to Baron & Kenny (1986), if all 4 steps are met, then math anxiety completely mediates the relation between parental involvement and mathematics achievement.

Findings / Results:

Description of the main findings with specific details.

As expected, parental involvement was positively correlated with mathematics achievement, and math anxiety was negatively correlated with mathematics achievement (see Table 2). Furthermore, parental involvement was negatively associated with math anxiety ($r = -1.46$, $p = .02$). The relation between parental involvement and mathematics achievement as mediated by math anxiety presented itself to be more nuanced than expected. Math anxiety mediated the relationship between algebraic reasoning and story problems. As Table 3 and 4 display, the standardized regression coefficients between parental involvement and both algebraic reasoning and story problems was significantly reduced when controlling for math anxiety. However, math anxiety did not mediate the relation between parental involvement and procedural skills (please insert Tables 3, 4 and 5 here).

Conclusions:

Description of conclusions, recommendations, and limitations based on findings.

The results of this study suggest that the role of math anxiety in understanding the relation between parental involvement and mathematics achievement depends on the type of mathematics. For algebraic reasoning and story problem outcomes, parental involvement might exert its influence on children's math achievement through reducing math anxiety. However, knowing a child's level of math anxiety does not help explain the relation between parental involvement and procedural skills. These findings suggest that the relation between parental involvement and overall mathematics achievement is multi-dimensional and that math anxiety is not the only underlying mechanism affecting this relationship.

Increasing mathematics achievement is important for all students, but especially for students in urban public schools that are characterized by low achievement. The findings in this study suggest that educational interventions that make it their focus to enhance parental involvement, may find students' mathematics achievement to no longer be hindered by the negative effects of math anxiety. This has important implications, as increased mathematics competence is associated with entry to science, technological, engineering, and mathematics disciplines in higher education (National Mathematics Advisory Panel, 2008). The results of this study and the importance of mathematics call for further research in order to develop practical interventions that will benefit students in urban contexts.

The cross-sectional design of this study precludes causal claims. Therefore, future research is needed to examine how this relation develops over time. Furthermore, since this study suggests that parental involvement cannot hinder the deleterious effects of math anxiety on all types of mathematics, future research is needed to test this model on more types of mathematical outcomes.

Thank you for reviewing this submission.

Appendices

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Appendix A. References

References are to be in APA version 6 format.

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Appendix B. Tables and Figures
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Table 1

Parental Involvement and Math Anxiety Scales

Scale	Items	α
1. Parental Involvement	1. I help my child study for math tests at home	.73
	2. I believe my child has trouble with math	
	3. I never do math activities with my child	
	4. I expect my child to get good grades in math	
	5. I believe my child will perform well in math in future grades	
2. Math Anxiety in Young Children	1. I worry about not doing well in math class	.81
	2. When it is time for math my head hurts	
	3. I get nervous about making a mistake in math class	
	4. I am scared in math class	
	5. Math gives me a stomachache	
	6. When it is time for math my heart beats fast	
	7. Getting out my math books makes me nervous	

Table 2

Descriptive Statistics

Variable	M (*SD*)	1	2	3	4
1. Contextual Math (Algebra)	25.28 (*21.85*)	--			
2. Procedural Math (SDMT)	33.49 (*24.99*)	.48**	--		
3. Parental Involvement	23.85 (*4.24*)	.27**	.28*	--	
4. Math Anxiety	12.71 (*5.56*)	-.31**	-.22*	-.27*	--

Note. For ease of interpretation, SDMT is presented in percentiles and the other variables are presented in raw scores; analyses were conducted on standard scores or factor scores.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 3

Algebraic Reasoning Mediation Model (Steps 1 through 4)

	B (SE)	*β*
Algebra		
Parental Involvement on Algebra F(1, 77) = 6.03, p = .02, R^2 = .074		
Parental Involvement	.68 (.28)*	.27
Parental Involvement on Reactions F(1, 77) = 5.85, p < .05, R^2 = .071		
Parental Involvement	-1.47 (.61)*	-.27
Reactions on Algebra F(1, 77) = 8.08, p < .01, R^2 = .096		
Reactions	-1.48 (.05)*	-.31
Mediation F(2, 76) = 5.81, p < .05, R^2 = .134		
Reactions	-.12 (.05)*	-.26
Parental Involvement	.51 (.28)	.203

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 4

Story Problems Mediation Model (Steps 1 through 4)

	B (SE)	*β*
Story Problems		
Parental Involvement on Story Problems F(1, 77) = 4.98, p < .05, R^2 = .061		
Parental Involvement	.97 (.44)*	.25
Parental Involvement on Reactions F(1, 77) = 5.85, p = .02, R^2 = .071		
Parental Involvement	-1.47 (.61)*	-.27
Reactions on Story Problems F(1, 77) = 11.36, p = .001, R^2 = .130		
Reactions	-.26 (.08)***	-.36
Mediation F(2, 76) = 6.87, p = .002, R^2 = .155		
Reactions	-.23 (.08)**	-.32
Parental Involvement	.64 (.43)	.16

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 5

Procedural Skills Mediation Model (Steps 1 through 4)

	B (SE)	*β*
Procedural Skills (SDMT)		
Parental Involvement on SDMT F(1, 77) = 6.46, p < .05, R^2 = .078		
Parental Involvement	12.57 (4.94)*	.28
Parental Involvement on Reactions F(1, 77) = 5.85, p = .02, R^2 = .071		
Parental Involvement	-1.47 (.61)*	-.27
Reactions on SDMT F(1, 77) = 3.95, p= .051, R^2 = .102		
Reactions	-1.82 (.92)*	-.22
Mediation F(2, 76) = 4.28, p < .05, R^2 = .049		
Reactions	-1.30 (.93)	-.16
Parental Involvement	10.65 (5.09)*	.24

*$p < .05$. **$p < .01$. ***$p < .001$.