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The Mediating Role of Fear of Negative Evaluation in the Relationship between Goal-Setting Styles, Attention Control, and Working Memory with Math Anxiety

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Abstract

The aim of this study was to examine the mediating role of fear of negative evaluation in the relationship between goal-setting styles, attention control, and working memory with math anxiety among students. The statistical population included high school students in Kermanshah during the 2023-2024 academic year, from which 357 students were selected as the sample using a cluster random sampling method. The research method was descriptive-correlational, utilizing path analysis. Research instruments included the Math Anxiety Scale (MAS-R, 2011), the Fear of Negative Evaluation Scale by Leary (1983), the Goal Orientation Questionnaire by Midgley et al. (1998), the Working Memory Questionnaire by Wället-Asouvi et al. (2012), and the Attention Control Scale by Derryberry and Reed (ACS, 2002).The results indicated that fear of negative evaluation has a significant positive relationship with math anxiety and serves as a mediator in the relationship between goal-setting styles and working memory with math anxiety. Specifically, mastery goal orientation and working memory were found to have a significant inverse relationship with fear of negative evaluation, while performance and avoidance goal orientations had a significant direct relationship. Therefore, to reduce math anxiety among students, efforts to decrease fear of negative evaluation, improve working memory, and promote mastery goal-setting are recommended.

Keywords: Math Anxiety, Fear of Negative Evaluation, Working Memory, Attention Control, Mastery Goal-Setting, Performance Goal-Setting, Avoidance Goal-Setting

Introduction

Math anxiety is defined as a "feeling of tension, apprehension, or fear" regarding activities involving mathematics (Ashcraft, 2002, p. 181). Psychological and physiological symptoms may manifest when individuals experience anxiety about math (Chang & Beilock, 2016). In recent years, math anxiety has garnered significant attention from researchers due to its negative correlation with students' mathematical achievement, emotional outcomes, and overall well-being (Dowker et al., 2016; Ramirez et al., 2018).

Math anxiety has been shown to align with the adoption of specific goal orientations, such as performance-avoidance and mastery-avoidance goals, which hinder mastery of content (Gonzalez-DeHass et al., 2017). Achievement goal theory (e.g., Dweck, 1986; Nicholls, 1984) has generated extensive literature on behaviors associated with achievement (e.g., learning, task engagement, persistence, response to failure). Within this framework, two main goal types are distinguished: mastery goals and performance goals. Mastery goals reflect a desire to understand a task, acquire new knowledge, and develop abilities, whereas performance goals represent a desire to demonstrate competence by seeking positive judgments.

Elliot (1999) and Pintrich (2000) extended this framework by proposing a two-dimensional model of achievement goals, identifying four goal orientations: mastery-approach, mastery-avoidance, performance-approach, and performance-avoidance. Since performance-oriented goals involve a focus on comparing oneself to others, it appears that mastery-oriented goals may lead to lower levels of math anxiety (Furner & Gonzalez-DeHass, 2011).

In addition to goal-setting, another critical factor related to math anxiety is executive functioning. Among executive functions, working memory and attention control were selected for this study due to their significance in relation to math anxiety. Attention control involves selective focus and maintaining attention on a task while ignoring potential distractions and shifting attention as needed (Anderson, 2002). Working memory, on the other hand, refers to the temporary storage and manipulation of information during cognitive tasks (Baddeley, 2003). These skills are associated with concurrent academic progress and future educational success (Best et al., 2011; McClelland et al., 2013).

Previous studies have traditionally identified math anxiety as a disruptive factor for working memory and attention control (Skagerlund et al., 2019; Živković et al., 2023; Orbach et al., 2020).however, in this study, working memory and attention control are not examined in the context of being affected by math anxiety. Given that research has shown the significant role of working memory and attention control in mathematical achievement (Waters et al., 2021), we sought to answer the question of whether adolescents' perception of their executive functions could influence their math anxiety.

Adolescents who perceive their executive functions as inadequate may experience heightened fear of negative evaluation, which in turn can lead to math anxiety. Fear of negative evaluation is defined as the apprehension about being evaluated by others, causing

discomfort regarding others' negative judgments, avoidance of situations where evaluation may occur, and an expectation of negative evaluation (Heimberg et al., 2014).

According to Lazarus and Folkman's transactional theory of stress and coping, individuals constantly evaluate stimuli in their environment. This evaluative process generates emotions, and stress is defined as exposure to stimuli that are appraised as harmful, threatening, or challenging, exceeding the individual's capacity to cope (Lazarus & Folkman, 1984).

Given that many students experience math anxiety in academic settings, which negatively impacts their mathematical achievement and their ability to fully utilize cognitive resources in mathematical tasks, investigating the factors contributing to math anxiety among adolescents is essential.

This study aims to examine whether there is a relationship between goal-setting styles and adolescents' perception of their executive functions, with the mediating role of fear of negative evaluation, in relation to math anxiety.

Methodology

Research Design

This study, based on its objectives, falls under the category of applied research. Regarding data collection and analysis methods, it is a non-experimental, correlational design using path analysis modeling. The statistical population consisted of all high school students in Kermanshah during the 2022-2023 academic year. Using a multistage cluster sampling method, 357 students were selected as the research sample.

Research Instruments

1. **Math Anxiety Scale (MAS-R):**This scale, developed by Bai in 2011, measures math anxiety using 14 items on a Likert scale ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). The content validity was confirmed through confirmatory factor analysis in the original study. Reliability was calculated using Cronbach's alpha, yielding a value of 0.85 in the original study and 0.90 in the present study.
2. **Short Form of Fear of Negative Evaluation Scale:**Developed by Leary in 1983, this scale measures individuals' anxiety experiences when faced with potential future negative evaluations using 12 items rated on a 5-point Likert scale. In Iran, the scale was standardized by Gharavand et al., and its validity was confirmed through various methods. The reliability of its three subscales, calculated via Cronbach's alpha, was 0.80, 0.81, and 0.82, respectively. In the present study, the Cronbach's alpha for the entire scale was 0.91.
3. **Goal Orientation Questionnaire:**This questionnaire, developed by Midgley et al. in 1998, measures three goal orientations: mastery, performance-approach, and performance-avoidance. It consists of 18 items scored on a Likert scale ranging from 1 ("Strongly Disagree") to 7 ("Strongly Agree"). The validity of the questionnaire was confirmed through confirmatory factor analysis in the original study. The reliability, calculated via Cronbach's alpha for the original subscales, was 0.83, 0.86, and 0.74,

respectively, for mastery, performance-approach, and performance-avoidance orientations. In the present study, the Cronbach's alpha values for these subscales were 0.73, 0.72, and 0.70, respectively.

4. **Working Memory Questionnaire (Wället-Asouvi et al., 2012):**This questionnaire measures working memory in daily life using 30 Likert-scale items. The reliability and validity of the questionnaire were confirmed in the original study. In the present study, the Cronbach's alpha coefficient was 0.95.
5. **Attention Control Scale (ACS; Derryberry & Reed, 2002):**This scale measures focus and shifting attention using 20 items. In the study by Mathews et al. (2013), the factor structure of the questionnaire was confirmed. Cronbach's alpha for the focus subscale was 0.82, and for the shift subscale, it was 0.71. In the present study, all negatively worded items related to shifting attention were modified to measure focus. The Cronbach's alpha for the scale in this study was 0.85.

Findings

Table 1 presents the descriptive statistics for the study sample, including mean, standard deviation, skewness, kurtosis, and Cronbach's alpha coefficients for the variables of interest. Data analysis was conducted using SPSS-16 and Lisrel-10 software.

Table 1. Descriptive Statistics of Research Variables and Cronbach's Alpha Coefficient

Variable	Min	Max	Mean	SD	Skewness	Kurtosis	α	R^2
Math Anxiety	1.00	5.00	2.8780	0.97311	0.088	-0.934	0.905	0.117
Fear of Negative Evaluation (FNE)	1.00	5.00	2.9477	1.06122	0.125	-0.979	0.910	0.151
Task Goal	1.00	7.00	4.6241	1.02711	-0.355	0.033	0.736	
Approach Goal	1.67	7.00	5.1401	0.84381	-1.165	1.416	0.720	
Avoidance Goal	1.33	6.83	4.8263	1.07276	-0.395	-0.318	0.706	
Working Memory	1.00	5.29	3.5885	0.74177	-0.665	0.958	0.928	
Attention Control	1.35	5.00	3.0755	0.69406	0.310	0.007	0.854	

Results

As shown in Table 1, the skewness and kurtosis values for all research variables fall between -2 and +2, indicating that the distribution of all variables is normal. Therefore, path analysis was deemed an appropriate method for data analysis.

To assess the mutual correlations between variables, Pearson's correlation coefficients were calculated. The results are presented in the correlation matrix in Table 2.

Table 2. Correlation Coefficients Between Variables

	1	2	3	4	5	6
Math anxiety						
FNE	.178**					
Task Goal	-.222**	-.124*				
Approach Goal	-.165**	.124*	.396**			
Avoid Goal	-.020	.135*	.352**	.430**		
W Memory	-.197**	-.278**	.099	.070	.013	
Contorol Attention	-.211**	-.167**	.112*	-.022	-.015	.584**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Pearson's correlation coefficient was used to examine the mutual relationships between variables. The results are presented in the correlation matrix in Table 2. As observed, at the significance level of $p < 0.01$, math anxiety showed significant relationships with fear of negative evaluation ($r = 0.17$), mastery goal orientation ($r = -0.22$), performance goal orientation ($r = -0.16$), working memory ($r = -0.19$), and attention control ($r = -0.21$).

At the significance level of $p < 0.05$, fear of negative evaluation was significantly related to mastery goal orientation ($r = -0.12$), performance goal orientation ($r = 0.12$), and avoidance goal orientation ($r = 0.13$). At $p < 0.01$, fear of negative evaluation was also significantly associated with working memory ($r = -0.27$) and attention control ($r = -0.16$).

Based on theoretical and empirical foundations, a conceptual model was developed to explain the structural relationships among the variables. It was hypothesized that cognitive abilities and perfectionism mediate the relationship between perceived parenting styles and obsessive beliefs.

To evaluate the model fit and estimate the effect coefficients, path analysis using the maximum likelihood method was employed. Descriptive indices indicated that all variables

approximated normal distribution, satisfying the normality assumption. Sample size adequacy, a critical factor in modeling, was also considered.

Bentler and Chou (1988) recommend that, under normal distribution of variables and the absence of outliers and missing values, the sample size can be reduced to five cases per estimated parameter. Thus, the sample size of 357 participants was deemed sufficient for this study.

The pairwise correlation scatterplots for all variables showed elliptical shapes, confirming the presence of linear relationships.

Table 3: Model Fit Indices

Fit Index	Chi-square/df	RMSEA	NFI	CFI	GFI
Value	0.84	0.000	0.998	1.000	0.999

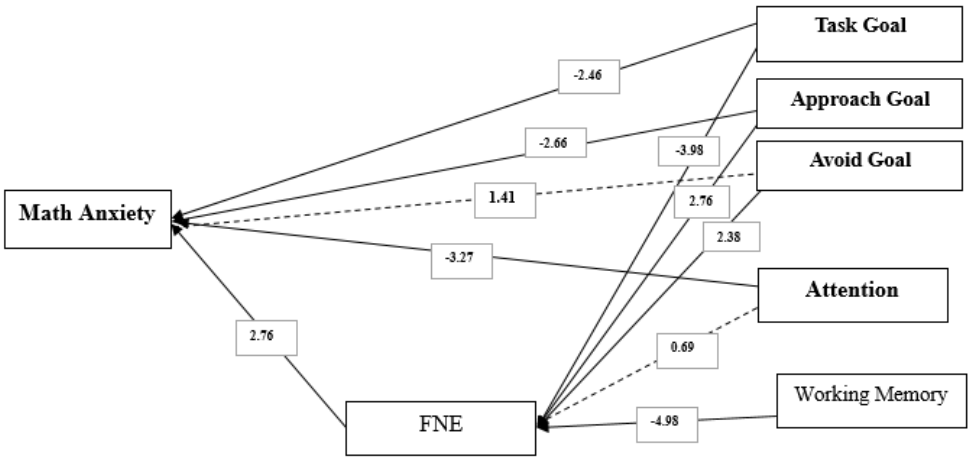

Figure 2 - T-values in the Significance Testing of the Hypothesized Research Model

Table 3 presents the model fit indices for the proposed model based on the data. According to Thompson (1999), a subset of overall fit indices, including Chi-square, Normed Fit Index (NFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA), are the most critical indicators of model fit. Therefore, these indices were calculated for the present study (Table 3). The results of the model fit indices indicate that the research model exhibits an acceptable fit.

As shown in Table 4, direct effects on math anxiety were significant. Specifically, mastery goals had a direct effect of -0.14 ($p < 0.05$), performance goals had a direct effect of -0.16 ($p < 0.01$), attention control had a direct effect of -0.17 ($p < 0.01$), and fear of negative evaluation had a direct effect of 0.15 ($p < 0.01$). In addition, direct effects on fear of negative

evaluation were also significant, with mastery goals showing an effect of -0.22 ($p < 0.001$), performance goals an effect of 0.18 ($p < 0.01$), avoidance goals an effect of 0.13 ($p < 0.05$), and working memory an effect of -4.94 ($p < 0.001$). Furthermore, indirect effects on math anxiety were significant, including mastery goals with an effect of -0.17 ($p < 0.05$), performance goals with an effect of -0.13 ($p < 0.05$), and working memory with an effect of -0.04 ($p < 0.05$).

Table 4: Estimates of Direct and Indirect Effects in the Final Model

Variable	R^2	t-value	Standardized Estimate	SE	Parameter Estimate	Effect Type
On Math Anxiety	0.11					Direct
- Task Goal		-2.44	-0.14	0.04	-0.14	Direct
- Approach Goal		-2.64	-0.16	0.06	-0.18	Direct
- Avoid Goal		1.40	0.08	0.07	0.07	Direct
- Attention Control		-3.24	-0.17	0.04	-0.24	Direct
- Fear of Negative Evaluation (FNE)		2.73	0.15	0.13	0.13	Direct
On Fear of Negative Evaluation (FNE)	0.15					Direct
- Task Goal		-3.95	-0.22	0.05	-0.24	Direct
- Approach Goal		3.13	0.18	0.07	0.23	Direct
- Avoid Goal		2.36	0.13	0.05	0.13	Direct
- Attention Control		0.68	0.04	0.09	0.07	Direct
- Working Memory		-4.94	-0.31	0.09	-0.44	Direct
On Math Anxiety (Indirect)						Indirect
- Task Goal		-2.26	-0.17	0.01	-0.17	Indirect
- Approach Goal		2.07	-0.13	0.01	-0.15	Indirect
- Avoid Goal		1.80	0.09	0.01	0.08	Indirect
- Attention Control		0.66	0.16	0.01	-0.23	Indirect
- Working Memory		-2.41	-0.04	0.02	-0.05	Indirect

Discussion and Conclusion

The results of the present study highlight the mediating role of fear of negative evaluation in the relationship between mastery, performance, and avoidance goals, as well as working memory, with math anxiety. Among the direct relationships, mastery goals, performance goals, and attention control showed significant associations with math anxiety.

The relationship between fear of negative evaluation and math anxiety aligns with the findings of Kumar et al. (2015), Dunning et al. (2020), and Carleton et al. (2011). This relationship is strong, demonstrating that while mastery and performance goals are inversely associated with math anxiety, the mediation of fear of negative evaluation transforms these into direct relationships.

The negative relationship between mastery approaches and math anxiety corresponds with the results of Rawsthorne and Elliot (1999). Mastery goals are typically associated with greater intrinsic interest and a more positive attitude toward tasks, which can lead to reduced math anxiety. Similarly, the negative association between mastery orientation and math anxiety aligns with findings by Elliot and Harackiewicz (1996).

Although research findings on the emotional outcomes of performance approaches are inconsistent, they generally suggest that performance goals aimed at avoiding incompetence diminish intrinsic motivation, whereas those aimed at achieving competence do not. Avoidance goals demonstrated a direct significant relationship with math anxiety but showed a positive association with math anxiety through the mediation of fear of negative evaluation, consistent with the findings of Elliot and Harackiewicz.

Controlled attention was inversely related to math anxiety, and working memory was negatively associated with fear of negative evaluation. These findings support Lazarus and Folkman's (1984) interactional theory of stress and coping. According to this theory, individuals continually evaluate stimuli in their environment, generating emotions when stimuli are perceived as threatening, challenging, or harmful. Stress is defined as exposure to stimuli that exceed an individual's coping capacity. Adolescents with lower perceived attention control are more likely to feel anxious in situations involving mathematics. However, this does not directly lead to fear of negative evaluation. Lower controlled attention may not result in negative evaluations from the environment but can impair math learning over time, eventually leading to math anxiety.

The relationship between working memory and fear of negative evaluation suggests that lower working memory capacity reduces the ability to respond appropriately to environmental demands, potentially leading to negative evaluations and fear of negative evaluation.

Working memory did not show a direct significant relationship with math anxiety but was indirectly associated with it through the mediation of fear of negative evaluation, underscoring the critical role of fear of negative evaluation in math anxiety.

This study was conducted with a sample of adolescent students, and caution is advised when generalizing the results to other populations. Given the reliance on self-report tools in this study, future research should incorporate more precise measurement tools. Strategies such as promoting mastery goals, enhancing working memory, improving attention control, and reducing students' fear of negative evaluation in classroom settings are recommended to mitigate math anxiety among students.

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