

Association between Maternal Cognitive Fusion and Depression and Children's Sadness Management in Students with Specific Learning Disorders through an Artificial Neural Network

Leila Eskandari¹, PhD Candidate;  Farzaneh Hooman^{2*}, PhD;  Parviz Asgari¹, PhD; Marjan Alizadeh¹, PhD

¹Department of Psychology, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran

²Department of Psychology, Shiraz Branch, Islamic Azad University, Shiraz, Iran

*Corresponding author: Farzaneh Hooman, PhD; Department of Psychology, Shiraz Branch, Islamic Azad University, Postal code: 74731-71987, Shiraz, Iran.

Tel: +98 71 36410041; Fax: +98 71 36410059; Email: n.psyhoman@gmail.com

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Abstract

Background: Children's behavioral issues may arise from maternal depression, which can also hinder a child's mental development compared to their peers. This study aimed to assess the correlation between maternal cognitive fusion, maternal depression, and children's management of sadness in students with specific learning disorders (SLD).

Methods: The statistical population for this descriptive-correlational study included all male and female fourth-graders and fifth-graders with SLD, along with their mothers, in Karaj, Alborz Province, Iran, in 2022. A multistage cluster sampling technique was employed to select a research sample of 252 individuals. The research utilized the Children's Sadness Management Scale (CSMS), Cognitive Fusion Questionnaire (CFQ), and Beck's Depression Inventory (BDI-13) as assessment tools. Data analysis involved Pearson's correlation coefficient, multiple regression, and an artificial neural network (ANN). The data were ultimately analyzed using SPSS version 27 and MATLAB-2019.

Results: The mean and standard deviation (SD) for maternal depression, maternal cognitive fusion, and children's sadness management were 27.96 ± 6.73 , 50.61 ± 10.49 , and 15.90 ± 4.43 , respectively. The research results indicated a positive and significant association between maternal cognitive fusion and children's sadness management ($P < 0.001$). Conversely, there was a negative and significant association between maternal depression and children's sadness management ($P < 0.001$). According to the ANN findings, maternal depression exhibited a stronger correlation with children's sadness management.

Conclusion: The findings highlighted that maternal depression exhibits the most substantial correlation with children's sadness management. Consequently, the development of training programs and workshops targeting the mitigation of maternal depression for mothers of children with SLD is recommended.

Keywords: Depression, Sadness, Specific learning disorder, Cognitive, Women

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1. Introduction

Students with Specific Learning Disorder (SLD) represent a group highly susceptible to internalizing or externalizing their emotions and feelings (1). SLD encompasses a diverse spectrum of disorders characterized by impairments in one or more fundamental cognitive processes. It leads children with average or above-average intelligence compared to their peers to encounter challenges in learning, listening, speaking, reading, writing, and mathematical calculations (2, 3). This disorder frequently results in academic failures and setbacks, predisposing affected students to emotional, behavioral, and social difficulties (4).

While sadness is a natural emotional response

in individuals, excessive sadness can jeopardize one's mental well-being and potentially lead to various disorders, such as depression (5). The capacity to regulate and moderate emotional arousal, particularly negative emotions like sadness, is a pivotal developmental milestone for children (6, 7). Acquiring emotional control is a fundamental part of a child's socialization process, with parental guidance playing a central role in this endeavor (8). Research demonstrated that children diagnosed with learning disabilities tend to score higher on assessments related to sadness and depression compared to their neurotypical peers (9, 10). Consequently, it becomes imperative to identify the factors contributing to emotional dysregulation, particularly in managing sadness, among students with SLD (11).

The influence of mothers on their children's emotional well-being should not be underestimated. Therefore, scrutinizing specific maternal traits, such as cognitive fusion, is essential. Pyszkowska and her colleagues (12) reported that parents of children with behavioral issues often grapple with social stigma. The internalization of this social stigma can lead to cognitive fusion, a novel psychological construct. Cognitive fusion emerges when individuals become entangled within their thought processes (13). It refers to a state in which an individual becomes less responsive to immediate realities and becomes heavily influenced by their thoughts as if they were absolute truths (14, 15). This phenomenon can also lead to behavioral manifestations and experiences taking precedence over other sources of behavioral regulation (16). Cognitive fusion is a term that amalgamates both social and cognitive components, confounding individuals to the extent that they eventually accept it as the accurate explanation for their own experiences, making it indistinguishable from their actual experiences (17).

Another factor that may influence children's sadness is maternal depression (18). Depression is a significant global health concern, recognized as a leading cause of disability worldwide and one of the most prevalent mental disorders with substantial economic implications for both individuals and society (19). Mothers experiencing depression may struggle to provide adequate support for their children, leading children to subconsciously conclude that they cannot rely on their mothers and that their actions do not affect their mothers' responses (20). The behavioral issues exhibited by the child can stem from maternal depression, which may also hinder the child's cognitive development, causing them to progress more slowly than their peers. However, diagnosing depression in children can be a complex task (21, 22). According to Chen and co-workers (18), parenting practices and maternal depression symptoms can influence adolescent depression symptoms.

Recent studies consistently emphasized the critical role of the family environment in regulating children's emotions (7, 18). The impact of maternal responses to their children's emotions underscores the significance of these reactions. In the context of SLD, the family environment, parental attitudes, family dynamics, and the child's involvement all assume pivotal roles. Typically, students with SLD come from families where they may have

lacked essential emotional connections with their parents during their developmental years. The quality of the mother-child bond profoundly influences individuals' emotional, cognitive, and social development into adulthood. In cases where mother-child communication is inadequate or improper, it can lead to mental health challenges in the child. The innovation of the present study lied in its focus on predicting the management of sadness in children with SLD based on cognitive fusion and maternal depression, an aspect that has not been previously explored. The study aimed to assess the association between maternal cognitive fusion and depression and the management of children's sadness among students with SLD.

2. Methods

The statistical population for this descriptive-correlational study comprised all male and female fourth-graders and fifth-graders with SLD and their mothers in Karaj, Alborz Province, Iran, during the academic year 2021–2022. The study employed a multistage cluster sampling technique to select a research sample of 252 mothers and their children. The sample size was determined as 252 individuals, considering the number of research variables and allowing for a 10% chance of participant dropout. Mothers were included if willing to participate, provided written informed consent for the research, submitted fully answered questionnaires, and possessed at least a middle school literacy level. Exclusion criteria encompassed a lack of willingness to continue participation and incomplete questionnaire submission.

Before selecting the sample, research permits were obtained from the university, and necessary coordination was established with Karaj's Education and Welfare Department. Subsequently, eight learning disorder centers in Karaj were identified. Following the acquisition of required permits, client files were reviewed to identify fourth-graders and fifth-graders invited to participate in the study once parental permission was granted. In adherence to ethical research principles, participants were assured that their personal information would be treated as confidential and kept anonymous.

2.1. Measurement Tools

2.1.1. Children's Sadness Management Scale (CSMS): Developed by Zeman and colleagues (23),

the CSMS assesses sadness management in children aged 6–14. This self-report scale comprises 12 items categorized into three subscales: dysregulated expression, emotion regulation coping, and inhibition. Responses are rated on a 3-point Likert scale (i.e., 1: rarely, 2: sometimes, and 3: often). The validity of the CSMS was confirmed through a content validity index (CVI) of 0.95 and a content validity ratio (CVR) of 0.90 (24). Tahmouresi and colleagues (25) reported a Cronbach's alpha coefficient of 0.76 for the CSMS. In this study, Cronbach's alpha for the scale was 0.80.

2.1.2. Cognitive Fusion Questionnaire (CFQ):

Developed by Gillanders and co-workers (26), the CFQ consists of a 13-item questionnaire with two subscales: fusion and de-fusion. Items are rated on a 7-point Likert scale (ranging from 1 to 7). The validity of the CFQ was established with a CVI of 0.92 and a CVR of 0.93 (27). Soltani and colleagues (27) reported a Cronbach's alpha coefficient of 0.92 for the CFQ. In the study, Cronbach's alpha for this tool was 0.86.

2.1.3. Beck's Depression Inventory (BDI-13):

This 13-item self-report questionnaire assesses specific depression symptoms across various semiotic fields, including emotional, cognitive, motivational, and physical aspects of depression. Each item is scored on a 4-point scale, ranging from (0) to (3), with a minimum possible score of 0 and a maximum of 39 (28). Dadfar and Kalibatseva (29) obtained a CVR value of 0.92 and a CVI value of 0.89 for the BDI-13. Additionally, the Cronbach's alpha coefficient in the study was found to be 0.89 (29), with a Cronbach's alpha of 0.90 for the BDI-13.

2.2. Statistical Analyses

Descriptive statistics, including mean and standard deviation and inferential statistics, such as Pearson's correlation coefficient and multiple regression, were employed for data analysis in SPSS version 27 to examine the predictive capabilities of cognitive fusion and maternal depression on children's sadness management. In this study, an

artificial neural network (ANN) was developed using MATLAB 2019, as it is the most accurate statistical method for predicting variables.

The primary research question addressed was: To what extent can cognitive fusion and maternal depression predict children's sadness management? Initially, the data for the network were divided into three categories: 70% for training, 15% for evaluation, and 15% for testing. The network had two inputs and one output as an Excel file and a matrix. The results indicated that using two hidden layers, one with one neuron in the second layer and five in the first, produced the most favorable outcomes. Given the uncertainty surrounding the ideal number of training replicates, the evaluation set data was presented to the network concurrently with the training set, and the network's optimized weights were determined using the Early Stopping Method. Training replicates were continued until the error reached a meager value or a preset minimum, whichever occurred first. Ultimately, the minimum value of the training set for all the data was used to confirm and select the optimal repetition rate.

3. Results

Descriptive data indicated that 65 (25.79%), 80 (31.75%), 74 (29.36%), and 33 (13.10%) of the mothers possessed middle school degrees, high school diplomas, bachelor's degrees, and master's degrees, respectively. The data also revealed that 120 (47.62%) children were male, and 132 (52.38%) were female. The mean age of mothers was 34.61 ± 3.79 . Furthermore, 92 (36.51%) mothers were employed, while 160 (63.49%) were housewives. Table 1 presents the research variables' mean, standard deviation (SD), and correlation coefficients. According to the correlation coefficients depicted in Table 1, a positive significant correlation existed between cognitive fusion and children's sadness management ($r=0.40$), and a negative significant correlation was observed between maternal depression and children's sadness management ($r=-0.470$).

Table 1: Mean, standard deviation, and correlation coefficients of research variables

Variables	Mean	SD	1	2	3
1- Children's sadness management	27.96	6.73	1		
2- Maternal cognitive fusion	50.61	10.49	0.50**	1	
3- Maternal depression	15.90	4.43	-0.47**	0.38**	1

** $P < 0.01$, SD: Standard Deviation

According to the results, cognitive fusion ($\beta=0.22, P<0.001$) and maternal depression ($\beta=0.44, P<0.001$) demonstrated a significant association with children’s sadness management (Table 2).

Figure 1 illustrates the neural network training process commencing with the input data. Based on Figure 1, the following observations can be made:

- The final mean squared error was small.
- The training set error exhibited behavior and characteristics nearly identical to the evaluation set error.
- Overfitting did not occur until Replicate 7, representing the best performance in the evaluation set.

The results indicated that the neural network achieved an accuracy of 0.73 in predicting children’s sadness management during the training phase. The prediction equation at this stage can be formulated as follows (In these equations, “Target” represents the criterion variable, and “Output” is the predictor variable):

$$\text{Output}=0.55*\text{Target}+13$$

During the evaluation phase, the neural network successfully predicted children’s sadness management with an accuracy of 0.78. The prediction equation for this stage is as follows:

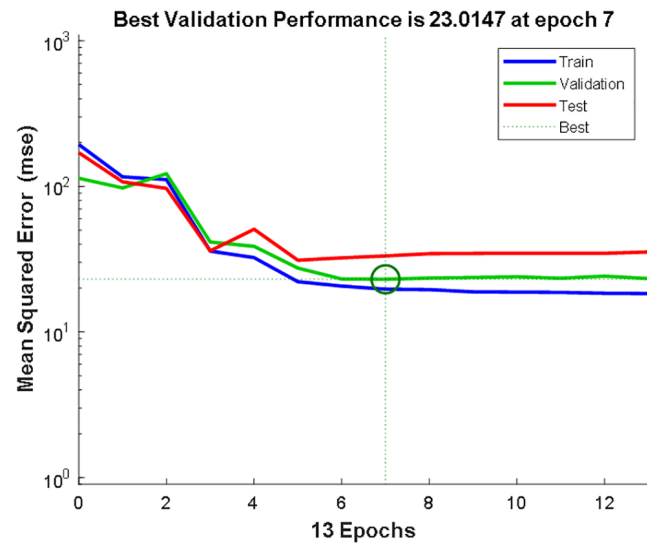


Figure 1: The figure shows the diagram of the network efficiency.

$$\text{Output}=0.55*\text{Target}+12$$

In the testing phase, the neural network achieved an accuracy of 0.56 in predicting children’s sadness management. The corresponding prediction equation is as follows:

$$\text{Output}=0.48*\text{Target}+15$$

Overall, the neural network demonstrated an accuracy of 0.71 in predicting children’s sadness management. The overall prediction equation is expressed as follows:

$$\text{Output}=0.54*\text{Target}+13$$

Table 2: Predicting sadness management of children with SLD based on maternal cognitive fusion and depression

Predictor variable	B	β	P
Maternal cognitive fusion	-0.10	-0.22	0.001
Maternal depression	-0.20	-0.44	0.001

SLD: Specific Learning Disorders

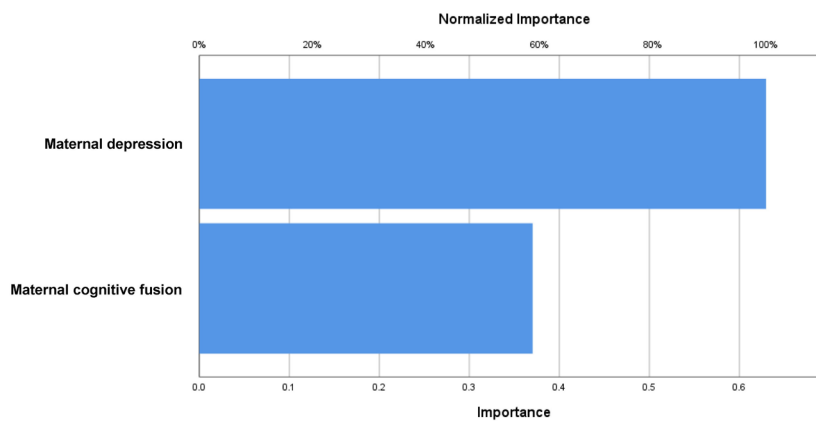


Figure 2: The figure shows the relative importance of the predictor variables.

This study also analyzed the importance and weight of cognitive fusion and maternal depression in predicting children's sadness management. The results revealed that maternal depression played a more significant role in predicting children's sadness management (Figure 2).

4. Discussion

This study aimed to investigate the association between maternal cognitive fusion and depression with children's sadness management in students with SLD. The first research finding indicated a statistically significant positive association between cognitive fusion and children's sadness management. Since this was the inaugural study examining the link between these two variables, no similar studies were available for comparative purposes. Nevertheless, Pyszkowska and colleagues (12) reported that parental cognitive fusion resulted in academic neglect, interpersonal difficulties, and impaired communication in children. Cognitive fusion, in essence, pertains to the capacity to merge and synthesize rational information (15). Children grappling with SLD confront additional hurdles in the learning process. Mothers of children with SLD can exert a substantial impact on their offspring's transition from despondency to contentment. Effective sadness management is pivotal in children's psychological well-being (22). Mothers characterized by higher levels of cognitive fusion are better equipped to devise optimal strategies for their children's sadness management. In essence, mothers with elevated cognitive fusion levels possess the ability to ameliorate and alleviate their children's anguish and distress. They can adeptly address their offspring's negative emotions and provide suitable remedies for their sorrow and discomfort (17). This form of sadness management can significantly enhance the emotional state of children with SLD.

The study findings also unveiled a statistically significant negative association between maternal depression and children's sadness management. In other words, maternal depression may exert an influence on the behavior and performance of children with SLD. In congruence with this discovery, Severo and co-workers (30) documented that maternal depression represents a risk factor for children's emotional, social, and cognitive development. Additionally, Hernández-Vásquez and colleagues (31) posited that children born to

mothers exhibiting moderate to severe depressive symptoms exhibited diminished emotional self-regulation. Maternal depression can lead to a decrease in a mother's attentiveness, interest, and support for her children.

Furthermore, this condition may hinder the development of a proper emotional bond with their offspring (21). These factors, coupled with the myriad challenges faced by children with SLD, exacerbate the sadness experienced by these children. For instance, a depressed mother may fail to adequately address her children's needs and problems, depriving them of essential support. This, in turn, may elevate the stress and anxiety levels in these children, negatively affecting their academic performance. Research indicated that children of depressed mothers often exhibit poorer academic performance, reduced creativity, and an increased prevalence of behavioral issues (19, 22).

Furthermore, unresolved childhood sadness can potentially manifest as psychological and behavioral problems in adulthood. Although not all children of depressed mothers inevitably encounter such difficulties, there is a noteworthy negative association between maternal depression and children's sadness management. Mothers wield significant influence in their children's lives, and managing sadness effectively is crucial in preventing potential future depression (32). Consequently, addressing the factors contributing to children's mismanagement of sadness is imperative.

4.1. Limitations

One research limitation pertains to the potential influence of participants' individual-family differences, personality traits, and disparities in attitudes and knowledge regarding the variables under study on the findings. Moreover, given that self-report questionnaires served as the primary data collection instruments, there is a possibility of inherent bias in the research data. Furthermore, it is essential to acknowledge that this study focused on elementary students with SLD and their mothers. Consequently, the generalizability of the findings to other demographic groups and populations must be exercised with caution. Therefore, it is advisable to undertake similar investigations involving different populations to attain more dependable results.

5. Conclusion

The research findings have effectively demonstrated a statistically significant association between maternal depression and cognitive fusion concerning children's management of sadness. Additionally, the ANN results have consistently revealed that maternal depression exhibits a stronger correlation with children's sadness management. In light of the pivotal roles played by maternal depression and cognitive fusion in the context of children's sadness management, it is highly recommended that tailored training programs and workshops be developed specifically for mothers of children with SLD. These programs aim to mitigate their stress levels and enhance their self-management of sadness.

Ethical Approval

This research was approved under the ethical approval code of IR.IAU.AHVAZ.REC.1402.051. Also, written informed consent was obtained from the participants.

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Authors' Contribution

Leila Eskandari: Substantial contributions to the conception and design of the work, acquisition, analysis, and interpretation of data for the work, reviewing the manuscript critically for important intellectual content. Farzaneh Hooman: Substantial contributions to the conception and design of the work, acquisition, analysis, and interpretation of data for the work, reviewing the manuscript critically for important intellectual content. Parviz Asgari: Contributions to the conception of the work, drafting the work and reviewing it critically for important intellectual content. Marjan Alizadeh: Contributions to the conception of the work, drafting the work and reviewing it critically for important intellectual content. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work,

such that the questions related to the accuracy or integrity of any part of the work.

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