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The Mediating Role of Theory of Mind in the Relationship Between Executive Functions and Marital Burnout Using Structural Equation Modeling and Artificial Neural Networks (SEM-ANN)

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A B S T R A C T

Purpose: This study aimed to investigate the mediating role of theory of mind (ToM) in the relationship between executive dysfunction and marital burnout.

Methods and Materials: The study employed a descriptive-correlational design with a sample of 300 married women from counseling centers in Tehran. Data were collected using the Barkley Deficits in Executive Functioning Scale, the Baron-Cohen Theory of Mind Questionnaire, and the Pines Couple Burnout Measure. To analyze the data, structural equation modeling (SEM) was used to examine the direct and indirect relationships between variables, and artificial neural networks (ANN) were employed to explore nonlinear and interactive effects.

Findings: The results showed a significant positive relationship between executive dysfunction and marital burnout, as well as a significant negative relationship between ToM and marital burnout. Mediation analysis revealed that ToM partially mediated the relationship between executive dysfunction and marital burnout. Both SEM and ANN analyses confirmed the robustness of the relationships between executive functions, ToM, and marital burnout, with executive dysfunction emerging as the strongest predictor of marital burnout.

Conclusion: The findings suggest that impairments in executive functions contribute to marital burnout both directly and indirectly by affecting ToM. Interventions aimed at improving executive functions and ToM, such as mindfulness-based programs and cognitive-behavioral therapies, may help reduce the risk of marital burnout. These results underscore the importance of cognitive and social processes in understanding and addressing relationship dissatisfaction and emotional exhaustion in marriages.

Keywords: *Executive functions, marital burnout, theory of mind, structural equation modeling, artificial neural networks.*

1. Introduction

In the fields of psychology and cognitive neuroscience, understanding the complex relationship between executive functions and social cognition, specifically theory of mind (ToM), has become a focal point for researchers (Wade et al., 2018). Executive functions, encompassing a wide range of cognitive processes such as inhibition, working memory, cognitive flexibility, and planning, are critical for goal-directed behavior and managing social interactions (Asadi Rajani, 2023; Pluck et al., 2020; Pourjaberi et al., 2023; Roghani et al., 2022; Williams et al., 2016). Theory of mind, the ability to attribute mental states such as beliefs, desires, and intentions to oneself and others, is equally crucial for understanding and predicting social behavior (Brodsky et al., 2022; Kloo et al., 2020). Recent studies suggest a deep interconnection between executive functions and ToM, with deficits in either domain having profound implications for social and cognitive development (Devine & Apperly, 2021; Devine et al., 2016; Yeh et al., 2010; Yeh et al., 2016).

The interplay between ToM and executive functioning has been extensively explored in both children and adults. Research has shown that the development of executive functions in early childhood directly influences ToM abilities later in life (Cantin et al., 2016; Wade et al., 2018; Yao et al., 2024). For example, Cantin and colleagues (2016) found that executive functioning predicted performance in tasks assessing both academic skills and ToM during the elementary school years (Cantin et al., 2016). Similarly, longitudinal studies have emphasized the significant role that executive functions play in the development of ToM and social competence (Chang-zhi et al., 2021; Devine & Apperly, 2021; Devine et al., 2016). Specifically, executive functions are necessary for the inhibition of one's own perspective in favor of understanding another's mental state—a key component of ToM (Qureshi & Monk, 2018; Williams et al., 2016).

The importance of ToM in social cognition extends beyond childhood, influencing behaviors in adulthood and across various contexts. Studies on adults have demonstrated that ToM remains a vital component of social interactions and decision-making, particularly in understanding irony, humor, and other complex social nuances (Cordonier et al., 2020). Additionally, impairments in ToM are associated with a variety of psychological disorders, including autism spectrum disorder (ASD), schizophrenia, and frontotemporal dementia (Brüne et al., 2020; Yeh et al., 2010; Yeh et al., 2016). In individuals with ASD, for instance, cognitive deficits that persist into adolescence may hinder the development of ToM, further complicating social interactions and emotional regulation (Cantio et al., 2018; Miranda et al., 2017).

A growing body of literature supports the idea that ToM and executive functions are not only interdependent but also essential for social adaptation and functioning. Deficits in either domain can lead to maladaptive behaviors, such as pathological lying, social withdrawal, and impaired social decision-making (Poletti et al., 2011; Vekety et al., 2022). For example, individuals with frontal lobe damage, which impairs executive functions, show marked difficulties in understanding others' mental states, leading to diminished ToM capabilities (Yeh et al., 2010; Yeh et al., 2016). These impairments are often more pronounced in patients with neurological conditions such as Huntington's disease, where altered ToM and executive dysfunction result in significant social and emotional challenges (Brüne et al., 2020).

The relationship between ToM and executive functions has also been examined in the context of neuroeconomic games, which simulate real-world social decision-making scenarios. Brüne et al. (2020) explored how individuals with Huntington's disease exhibited altered third-party punishment behaviors, providing insight into the role of executive functions and ToM in decision-making processes. These findings suggest that deficits in ToM and executive functions can profoundly affect social interactions and the ability to navigate complex social environments (Brüne et al., 2020). In children, the development of ToM and executive functions has been linked to both academic achievement and social competence (Crooks et al., 2020; Devine & Apperly, 2021; Devine et al., 2016). For instance, children who exhibit higher levels of executive functioning tend to perform better on ToM tasks, which in turn predicts better social interactions and prosocial behaviors (Wade et al., 2018; Williams et al., 2016). Moreover, studies have shown that bilingualism may enhance ToM abilities, suggesting that language and cognitive flexibility play a role in the development of social cognition (Rubio-Fernández, 2016; Rubio-Fernandez et al., 2021; Yu et al., 2021). These findings highlight the importance of early interventions aimed at improving executive functions to foster better ToM and social outcomes in children.

The present study builds on this growing body of research by examining the mediating role of ToM in the relationship between executive functions and marital burnout. Marital burnout, characterized by emotional exhaustion,

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detachment, and a sense of ineffectiveness in the relationship, has been linked to both cognitive and emotional factors, including deficits in executive functions. Given the significant role that executive functions play in managing emotions, regulating behavior, and navigating social interactions, it is plausible that deficits in these cognitive processes contribute to marital burnout (Brodsky et al., 2022; Javidan, 2022). Moreover, as ToM is critical for understanding and responding to a partner's emotional and mental states, impairments in ToM may exacerbate marital burnout by hindering effective communication and emotional intimacy (Galvin et al., 2022).

In conclusion, this study aimed to investigate the mediating role of theory of mind (ToM) in the relationship between executive dysfunction and marital burnout. The findings will not only advance our understanding of the cognitive and social mechanisms underlying marital burnout but also inform the development of targeted interventions aimed at improving executive functioning and ToM to mitigate the negative effects of burnout on marital relationships.

2. Methods and Materials

2.1. Study Design and Participants

The present research, considering its subject, was descriptive and correlational. The statistical population of the study included married women residing in districts one and two of Tehran in 2023. Initially, individuals meeting the eligibility criteria were invited to participate in this study through announcements made at counseling and psychology centers in districts one and two. Then, through a preliminary interview conducted by the first author of this article, 323 individuals who were interested in participating in the study and met the inclusion and exclusion criteria were selected. Based on the recommendation by Guadagnoli and Velicer (1998) that studies employing modeling approaches should have a sample size between 300 to 450, data were collected from 300 available married women volunteers. Inclusion criteria included an age range of 20 to 45 years, 2 to 5 years of marriage experience, at least a high school diploma, the ability to respond to the research questionnaires, no intention or attempt to divorce, self-reported psychological health, and willingness to participate in the study. Exclusion criteria included having a psychotic disorder, substance abuse (self-reported), and incomplete questionnaire responses.

To adhere to ethical research principles, before implementing the research, explanations regarding the goals and necessity of the study were provided to the participants, and voluntary participation was emphasized. Participants were also informed that their data would remain confidential with the researcher. They were asked to provide their email in the questionnaire if they wished to receive the results.

The research procedure was as follows: after selecting the sample group, a semi-structured interview was conducted with each participant. During this interview, demographic characteristics were collected, and the research's objectives and inclusion and exclusion criteria were reviewed. Couples in which one or both partners did not meet the inclusion criteria were excluded from the sample. All women experiencing marital burnout completed the executive functioning and theory of mind questionnaires. It is noteworthy that the order of the questionnaires was randomized to control for any effects of order on completion.

2.2. Measures

2.2.1. Couple Burnout

The Couple Burnout Measure (CBM) was developed by Pines in 1996. This self-report questionnaire is designed to assess the degree of marital burnout in couples and contains 21 items across three main subscales: physical fatigue, emotional fatigue, and psychological fatigue. Reliability analysis of the Couple Burnout Measure revealed internal consistency with Cronbach's alpha coefficients ranging from 0.84 to 0.90. The questionnaire's validity was confirmed by negative correlations with positive relational characteristics such as positive views on communication, conversation quality, feelings of security, self-actualization, purposefulness, emotional attraction to the spouse, and sexual relationship quality. Test-retest reliability was reported as 0.89 over a one-month period, 0.76 over a two-month period, and 0.66 over a four-month period. Internal consistency for most participants was measured with an alpha coefficient ranging from 0.91 to 0.93. In Iran, Novidi (2005) measured Cronbach's alpha for this questionnaire in a sample of 140 nurses and 120 teachers, which was 0.86 (Majlesi et al., 2023). In the present study, Cronbach's alpha for the questionnaire was found to be 0.836.

2.2.2. Theory of Mind

Baron-Cohen Theory of Mind Questionnaire (BC-ToM-Q) was developed by Baron-Cohen et al. (2001) to assess theory of mind in adults. The test includes 20 short stories from everyday life, of which 10 involve incorrect behavior.

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At the end of each story, 6 questions related to theory of mind and 2 control questions are asked. In stories 2, 4, 7, 11, 12, 13, 14, 15, 16, and 18, the "slip" occurs. There is no time limit for responding. Scoring is such that each correct answer in stories with incorrect behavior earns one point. If the participant answers “no” to the first question of a story, no further questions are asked, and all subsequent answers are scored as zero. Scoring for the “slip” stories is such that the correct answer is “yes,” and the incorrect answer is “no.” Each correct answer earns one point. In the control questions, the correct answer is “no,” and the incorrect answer is “yes.” If a participant answers “no” to the first control question, the remaining control questions are asked. These control questions ensure the participant remembers or correctly understands the story. If a participant answers the control questions incorrectly, the other answers from that story are discarded. Thus, the score on the "slip" test ranges from zero to 60. Baron-Cohen et al. reported an inter-rater reliability of 0.95 for this test, and the Cronbach's alpha for the entire test in Iran was reported as 0.710 (Baron-Cohen, 2001; Nejati, 2023). In the present study, Cronbach’s alpha for the slip detection test was found to be 0.74.

2.2.3. Executive Functioning

Barkley Deficits in Executive Functioning Scale (2012): This questionnaire consists of 89 items developed by Barkley in 2012. It includes five subscales, and higher scores in each subscale may indicate a deficit in that specific domain of executive functioning in daily activities. Responses are rated on a four-point Likert scale (1 = never to 4 = always). The scale includes five subscales that assess five executive functions: (1) self-management of time, (2) self-organization/problem-solving, (3) self-control/inhibition, (4) self-motivation, and (5) self-regulation of emotion. The scoring method is such that items 1, 6, 14, 16, 24, 49, 50, 55, 60, 65, and 69 are reverse scored. Individual scores are obtained by summing each subscale. Higher scores in each subscale may indicate a deficit in that area of executive functioning. The total score ranges from 89 to 356, with scores above 232 indicating deficits in executive functioning. Additionally, normative data tables are provided, separated by age and gender. The Cronbach's alpha for the entire scale was 0.91, and for the subscales of self-management of time, self-organization/problem-solving, self-control/inhibition, self-motivation, and self-regulation of emotion, the coefficients were 0.94, 0.93, 0.91, and 0.94, respectively. Test-retest reliability for the entire scale was 0.74, and for the subscales, coefficients ranged from 0.83 to 0.90. In the Iranian population, the results of Mashhadi et al.'s study using confirmatory factor analysis indicated that the five-factor model of Barkley’s Deficits in Executive Functioning Scale had good fit in the Iranian population. Thus, the factor validity was confirmed. Cronbach’s alpha for the subscales ranged from 0.80 to 0.92, and for the entire scale, it was 0.96 (Kahaki, 2024; Rahmani et al., 2024). In the present study, Cronbach’s alpha for the subscales ranged from 0.76 to 0.89, and for the entire scale, it was 0.89.

2.3. Data Analysis

To model the factors predicting marital burnout among couples, a combined structural equation modeling-artificial neural network (SEM-ANN) approach was used. Marital burnout was predicted using the Pines (1996) Couple Burnout Measure (CBM), the Baron-Cohen Theory of Mind Questionnaire (BC-ToM-Q), and the Barkley Deficits in Executive Functioning Scale. SEM was used to assess direct and indirect linear relationships. ANN was sequentially applied to enhance SEM by calculating nonlinear and interactive effects that SEM does not account for. Artificial neural networks were employed to analyze, complement, and validate the structural equation modeling approach and to measure the effectiveness of constructs used to predict marital burnout. A multilayer perceptron, the most common and widespread ANN method, was employed. ANN includes three layers: input, hidden, and output. In this study, ANN analysis was conducted using SPSS version 24. The SEM-derived model was divided into four ANN models, each with a single output variable. Model 1 included marital burnout as the output variable and executive functions and theory of mind as the two predictor variables.

3. Findings and Results

The demographic data of the participants showed that the majority of respondents (40%) were between the ages of 35 and 45 (n = 120), followed by 31.7% aged 25 to 35 (n = 95), and 28.3% aged 45 and older (n = 85). In terms of educational background, most participants held a bachelor's degree (40%, n = 121), followed by 29% with an associate degree (n = 87), 23% with a master's degree (n = 69), and 8% with a doctoral degree (n = 23). Regarding the number of children, 60% of the participants had one child (n = 181), while 40% had two or more children (n = 119).

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Table 1

Central Tendencies, Dispersion Indices, and Z Statistics for Normality Test of Data Distribution

Variables	Mean	SD	Skewness	Kurtosis	Z	p-value
Time Management	34.327	7.187	-0.055	-0.272	0.032	0.200
Organization	42.396	7.986	0.132	0.054	0.041	0.200
Inhibition	30.864	7.565	0.056	0.046	0.047	0.200
Self-Motivation	20.485	5.424	0.290	0.245	0.057	0.200
Emotion Regulation	23.763	6.179	-0.082	-0.199	0.034	0.200
Executive Dysfunction	151.835	14.605	0.170	-0.144	0.039	0.200
Theory of Mind (ToM)	11.348	3.954	-0.051	-0.224	0.039	0.200
Marital Burnout (MB)	71.627	9.044	-0.082	-0.394	0.040	0.200

The results in Table 1 indicate that none of the research variables show serious deviations from a normal distribution. The skewness values are within the range (-2, 2), and kurtosis values are within the range (-3, 3). Thus, the distribution of the data can be assumed to be approximately normal. In Table 2, the correlation matrix of the research variables is presented.

Table 2

Correlation Matrix of Research Variables

Variables	Executive Dysfunction	Theory of Mind	Marital Burnout
Executive Dysfunction	1	-0.259**	0.311**
Theory of Mind	-0.259**	1	-0.281**
Marital Burnout	0.311**	-0.281**	1

**p<0.01

As shown in Table 2, there is a significant positive correlation between executive dysfunction and marital burnout at the 0.01 level. Additionally, there is a significant negative correlation between theory of mind and marital burnout at the 0.01 level.

Table 3

Correlation Matrix Based on Heterotrait-Monotrait (HTMT) Ratio

Variables	Executive Dysfunction	Theory of Mind	Marital Burnout
Executive Dysfunction	1		
Theory of Mind	-0.501**	1	
Marital Burnout	0.512**	-0.511**	1

To assess discriminant validity, both the Fornell-Larcker criterion and the HTMT ratio of correlations were used. As shown in Table 4, based on the Fornell-Larcker criterion, the square root of the shared variance (on the diagonal) for the variables is larger than their off-diagonal correlations. Additionally, the HTMT values for the model variables ranged from 0.441 to 0.518, which are below the recommended threshold of 0.85. Therefore, the proposed model demonstrates satisfactory discriminant validity.

Table 4

Convergent Validity and Reliability of Research Variables

Variables	CA	CR	DG rho	AVE	SR AVE	VIF
Executive Functions (EF)	0.922	0.894	0.915	0.713	0.844	1.490
Theory of Mind (ToM)	0.886	0.866	0.904	0.656	0.810	1.150
Marital Burnout (MB)	0.866	0.806	0.849	0.699	0.836	1.910

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To address the main research question regarding whether the model explaining marital burnout based on executive functions and the mediating role of theory of mind fits the empirical data, structural equation modeling (SEM) using AMOS-26 was employed. The main fit indices are reported in Table 5.

Table 5

Interpretation of Fit Indices for the Structural Equation Model

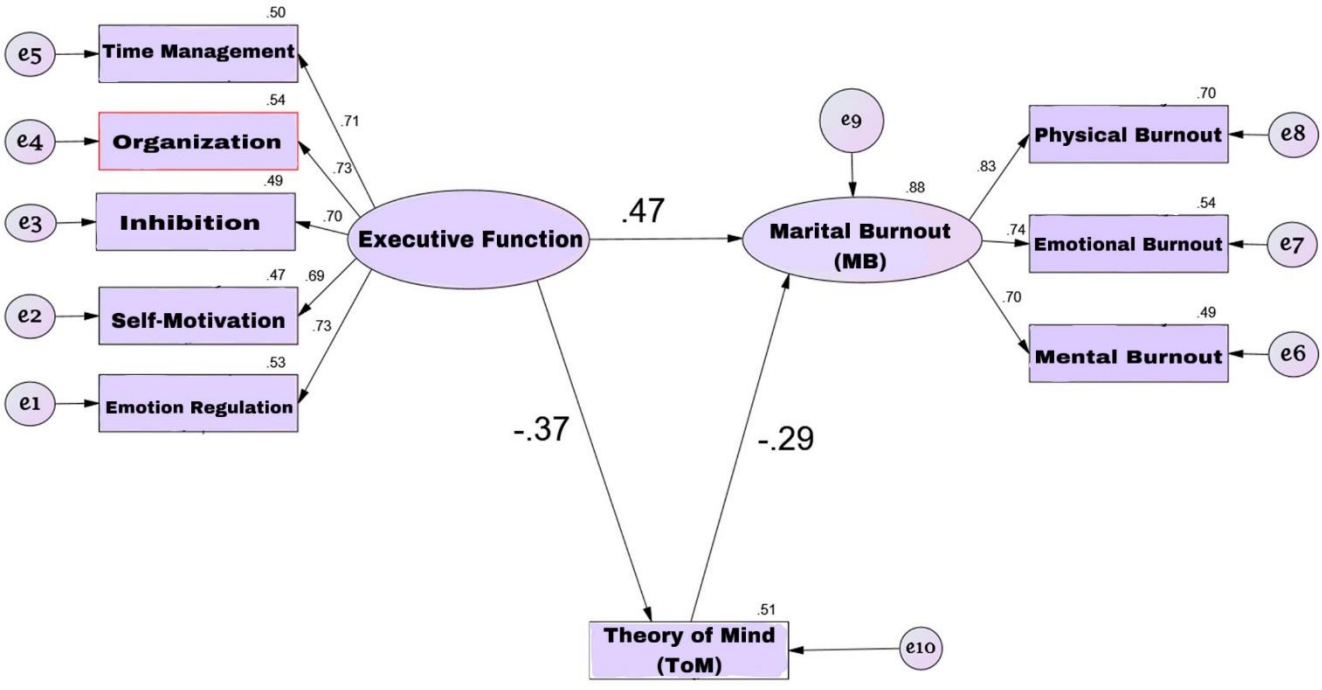
Fit Index	CMIN	DF	CMIN/DF	CFI	RMSEA	PClose
Obtained Value	45.223	25	1.809	0.976	0.064	0.207
Threshold Value	--	--	1-3	>0.95	<0.06	>0.05
Interpretation	--	--	Excellent	Excellent	Acceptable	Excellent

Table 5 includes the fit indices for the structural equation model: CMIN = 45.223; CMIN/DF = 1.809; CFI = 0.976; RMSEA = 0.064; and PClose = 0.207. All indices fall within the acceptable range, indicating that the model provides an excellent fit to the observed data. Thus, this model is appropriate for the data and research structure.

The R^2 index shows the explained variance for endogenous latent variables. The R^2 value for marital burnout is 0.88, meaning that all components of executive functions and theory of mind predict 88.1% of the variance in marital burnout among couples, which is considered strong. The R^2 value for theory of mind is 50.7%, indicating that the components of executive functions predict 50.7% of the variance in theory of mind, which is also strong. Figure 1 shows the standardized path coefficients. The highest coefficient (0.47) corresponds to the path from executive functions to marital burnout, and the lowest coefficient (0.29) is for the path from theory of mind to marital burnout. The direct and indirect path coefficients for the research variables are all significant.

Figure 1

Tested Model with Standardized Path Coefficients



As shown in Figure 1, the model reveals direct and indirect effects of executive functions on marital burnout. Table 6 reports the direct effects.

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Table 6

Direct Path Coefficients of Executive Functions and Theory of Mind on Marital Burnout

Direct Paths	Beta (β)	SE	CR	Critical Value
Executive Functions → ToM	-0.372	0.109	-9.146	0.001
Executive Functions → MB	0.468	0.135	-8.039	0.001
ToM → MB	0.288	0.068	-6.002	0.001

In addition to the direct relationships, the mediating effects of theory of mind on the relationship between executive functions and marital burnout were examined. Table 7 presents the indirect effects, and it is shown that the p-value for the structural paths is less than 0.05. The results from the bootstrap test in Table 7 indicate that the indirect paths are significant with 95% confidence.

Table 7

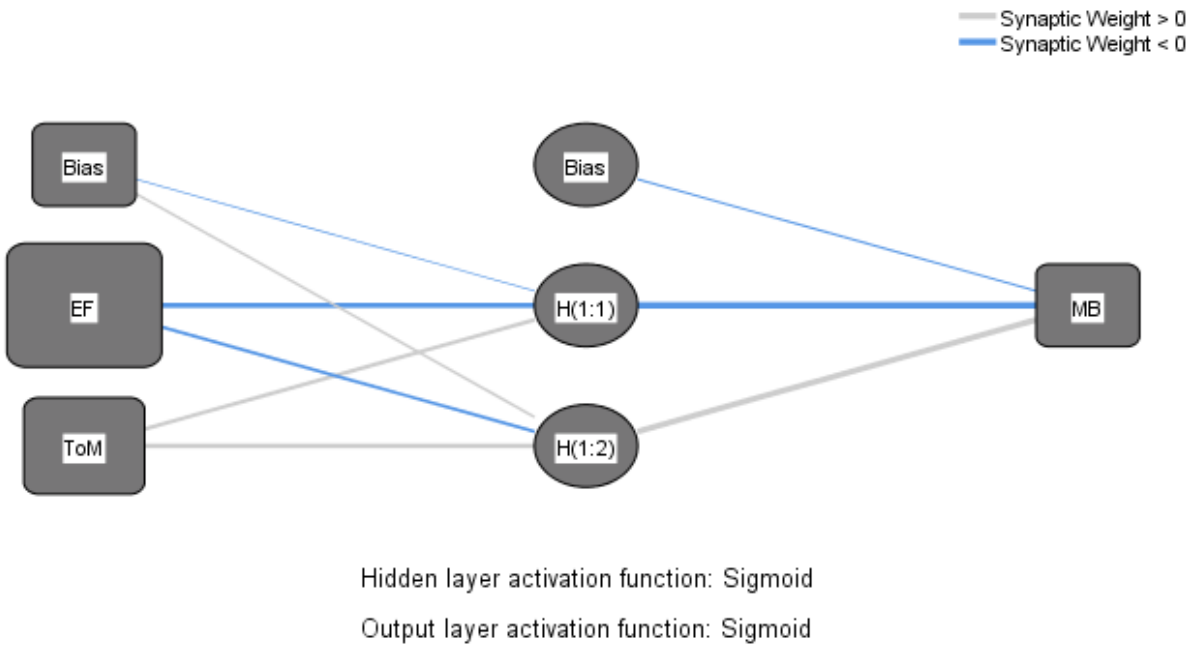
Bootstrap Results for the Indirect Effects of Executive Functions on Marital Burnout through Theory of Mind

Indirect Paths	Path Coefficient	Bootstrap SE	Lower Bound	Upper Bound
Executive Functions → ToM → MB	-0.081	0.033	-0.152	-0.029

As discussed in the methodology section, ANN analysis was used in the second stage of analysis. Significant hypothetical predictors were used as inputs for the ANN to emphasize the relative importance of each predictor variable. ANN provides more accurate predictions compared to SEM approaches.

Figure 2

Artificial Neural Network Model (EF: Executive Functions; ToM: Theory of Mind; MB: Marital Burnout)



The ANN analysis was used to validate the study's hypotheses. Non-normal data distribution and nonlinear correlations between dependent and independent variables were the main reasons for implementing ANN. Moreover, ANN is robust against noise, outliers, and small sample sizes. IBM SPSS software's neural network module was used for ANN analysis. A multilayer perceptron identified the effect of executive functions on marital burnout (Figure

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2). Hyperbolic functions were used for hidden and output layer activation, and standardization was used as the rescaling method for the dependent and independent variables. Figure 2 shows the multilayer perceptron model identifying the effects of executive functions on marital burnout.

The prediction accuracy of the ANN model was calculated using the root mean square error (RMSE) for both training (80%) and testing (20%) data sets (10 iterations). As shown in Table 8, the RMSE values for both the training and testing data sets indicate that the ANN model accurately captures the relationships between predictors and outcomes. Lower RMSE values indicate higher prediction accuracy and better data fit. Table 8 shows the RMSE results for both the training and testing stages.

Table 8

RMSE Values for ANN Model (Total Sample = 300)

Network	RMSE (Training)	RMSE (Testing)
ANN1	0.568	0.540
ANN2	0.566	0.664
ANN3	0.589	0.441
ANN4	0.592	0.430
ANN5	0.591	0.770
ANN6	0.586	0.760
ANN7	0.594	0.473
ANN8	0.583	0.543
ANN9	0.591	0.766
ANN10	0.602	0.631
Average	0.586	0.602
SD	0.011	0.135

Table 9 shows the sensitivity analysis results. Sensitivity analysis was used to rank variables based on their normalized relative importance to the dependent variable. The sensitivity analysis indicates that executive functions are the most important predictor, followed by theory of mind.

Table 9

Sensitivity Analysis

Variables	ANN1	ANN2	ANN3	ANN4	ANN5	ANN6	ANN7	ANN8	ANN9	ANN10	AI	NI (%)
ToM	0.619	0.697	0.668	1.000	0.825	0.851	0.297	1.000	0.835	0.542	0.734	0.754
EF	1.000	1.000	1.000	0.861	1.000	1.000	1.000	0.863	1.000	1.000	0.972	1.000

Note: Executive Functions (EF); Theory of Mind (ToM); Average Importance (AI); Normalized Importance (NI).

4. Discussion and Conclusion

The present study sought to investigate the relationship between executive functions, theory of mind (ToM), and marital burnout among married women. Specifically, the study explored the mediating role of ToM in the relationship between executive dysfunction and marital burnout. The findings revealed significant positive correlations between executive dysfunction and marital burnout, as well as significant negative correlations between ToM and marital burnout. Furthermore, the results supported the hypothesis that ToM plays a mediating role in the relationship between executive dysfunction and marital burnout, as demonstrated through both structural equation modeling (SEM) and artificial neural network (ANN) analysis.

The positive relationship between executive dysfunction and marital burnout aligns with previous research, which suggests that impairments in executive functions, such as inhibition, cognitive flexibility, and working memory, can contribute to emotional regulation difficulties and increased stress in interpersonal relationships (Clemente, 2023; Jankowski & Holas, 2020). Poor executive functioning may hinder individuals' ability to manage conflict, communicate effectively, and maintain emotional control in their marriages, leading to feelings of exhaustion, detachment, and dissatisfaction (Pluck et al., 2020). This is particularly relevant in the context of marital burnout, where individuals

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experience emotional fatigue and a sense of ineffectiveness in their relationship. Our findings are consistent with research by Crooks et al. (2020), which demonstrated that deficits in executive functioning are associated with increased behavioral problems and emotional dysregulation, both of which are key contributors to burnout in marital relationships (Crooks et al., 2020).

The results also indicated a significant negative relationship between ToM and marital burnout. This finding highlights the critical role of social cognition in marital satisfaction and emotional well-being. ToM, which involves understanding and predicting the mental states of others, is essential for effective communication, empathy, and perspective-taking in relationships (Brodsky et al., 2022). Impairments in ToM may lead to misunderstandings, misinterpretations, and reduced emotional intimacy between partners, contributing to the development of marital burnout (Galvin et al., 2022). Previous studies have similarly found that individuals with poor ToM skills struggle with social interactions and are more likely to experience relationship difficulties (Brüne et al., 2020; Cordonier et al., 2020). In the context of marriage, the inability to accurately infer a partner's thoughts and emotions can lead to unresolved conflicts, emotional distancing, and dissatisfaction, all of which are associated with burnout.

The mediation analysis further supported the hypothesis that ToM plays a mediating role in the relationship between executive dysfunction and marital burnout. This finding suggests that executive dysfunction indirectly contributes to marital burnout by impairing ToM, which in turn exacerbates relationship difficulties. This result aligns with the developmental perspective that executive functions are foundational to the development of ToM (Devine & Apperly, 2021; Devine et al., 2016). Specifically, executive functions such as cognitive flexibility and inhibition are necessary for individuals to set aside their own perspectives and consider the mental states of others (Yeh et al., 2016). Deficits in these cognitive processes may limit individuals' ability to engage in perspective-taking and empathy, leading to increased interpersonal conflict and emotional exhaustion within marriages (Kong et al., 2021). This aligns with the findings of Cantin et al. (2016), who showed that stronger executive functions were predictive of better ToM abilities in children, and with subsequent research indicating that these relationships persist into adulthood (Brodsky et al., 2022; Cantin et al., 2016; Devine & Apperly, 2021; Devine et al., 2016).

The use of both SEM and ANN approaches in the analysis provided a more comprehensive understanding of the relationships between executive functions, ToM, and marital burnout. SEM allowed for the examination of linear relationships, while ANN captured nonlinear and interactive effects, offering a nuanced view of how these cognitive and social processes interact. The ANN results reinforced the importance of both executive functions and ToM in predicting marital burnout, with executive dysfunction emerging as the strongest predictor. These findings are consistent with previous studies that have utilized machine learning approaches to model complex relationships between cognitive and social factors (Nguyen et al., 2022). The robust findings across both SEM and ANN methodologies provide strong evidence for the critical role that executive functions and ToM play in marital well-being.

One novel aspect of this study is its focus on the interplay between cognitive and social factors in predicting marital burnout. While much of the previous research on marital satisfaction and burnout has focused on emotional and relational factors, such as communication styles and conflict resolution strategies, this study highlights the importance of underlying cognitive processes (Wade et al., 2018). The results suggest that interventions aimed at improving executive functions and ToM may have significant benefits for marital relationships, particularly for individuals at risk of burnout. For example, mindfulness-based interventions, which have been shown to improve both executive functions and social cognition, may be effective in reducing marital burnout by enhancing individuals' ability to regulate their emotions and engage in perspective-taking (Nazaribadie et al., 2021; Zivnuska et al., 2016).

The findings of this study also have implications for clinical practice, particularly in the context of couples therapy. Traditional therapeutic approaches often focus on improving communication and emotional intimacy between partners. However, the results of this study suggest that addressing underlying cognitive deficits, such as executive dysfunction, may also be critical for improving relationship outcomes. Interventions that target both cognitive and social processes, such as cognitive-behavioral therapy (CBT) or social cognition training, may be particularly effective in reducing marital burnout and improving overall relationship satisfaction (Cavallini et al., 2013; Kral et al., 2019).

Despite the significant contributions of this study, several limitations should be acknowledged. First, the study relied on self-report measures for assessing executive functions, ToM, and marital burnout, which may introduce response

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biases. Future research should consider incorporating objective measures of cognitive functioning, such as neuropsychological assessments, to complement self-report data. Additionally, the cross-sectional design of the study limits the ability to draw causal conclusions about the relationships between executive functions, ToM, and marital burnout. Longitudinal studies are needed to examine how changes in cognitive functioning and social cognition over time influence marital satisfaction and burnout.

Second, the sample was limited to married women from specific districts in Tehran, which may limit the generalizability of the findings to other populations. Future research should aim to include more diverse samples in terms of gender, cultural background, and socioeconomic status to ensure the broader applicability of the results. Furthermore, this study focused solely on the relationship between executive functions, ToM, and marital burnout, without considering other potential moderating or mediating factors, such as personality traits, emotional intelligence, or relationship dynamics. Future studies could explore how these variables interact with cognitive and social processes to influence marital outcomes.

Finally, while the use of SEM and ANN provided valuable insights into the relationships between the study variables, these methodologies also have limitations. SEM assumes linear relationships between variables, which may not fully capture the complexity of the interactions between executive functions, ToM, and marital burnout. Although ANN allows for the modeling of nonlinear and interactive effects, it can be difficult to interpret the specific pathways and mechanisms underlying these relationships. Future research could benefit from employing additional advanced statistical techniques, such as latent growth modeling or mediation analysis with multiple mediators, to further elucidate the mechanisms driving marital burnout.

Building on the findings of this study, several avenues for future research can be pursued. First, future studies should aim to investigate the longitudinal relationship between executive functions, ToM, and marital burnout. By following couples over time, researchers can better understand how changes in cognitive and social functioning contribute to the development or alleviation of burnout in marital relationships. This would also help to establish causal relationships and identify critical periods for intervention.

Second, future research should explore the potential moderating and mediating factors that may influence the relationship between executive functions, ToM, and marital burnout. For example, it would be valuable to examine how individual differences in personality traits, emotional intelligence, or attachment styles interact with cognitive and social processes to affect marital outcomes. Additionally, research could investigate how relationship dynamics, such as communication patterns or conflict resolution strategies, mediate the effects of executive dysfunction and ToM impairments on marital burnout.

Finally, future studies should consider expanding the scope of the research to include different populations. It would be interesting to explore whether the relationships between executive functions, ToM, and marital burnout differ across genders, cultures, or relationship types. For instance, investigating these relationships in same-sex couples, couples with children, or couples experiencing chronic illness or financial stress could provide valuable insights into how cognitive and social factors influence marital outcomes in diverse contexts.

In terms of practical applications, this study highlights the importance of addressing both cognitive and social factors in interventions aimed at reducing marital burnout. Couples therapy should consider incorporating strategies to improve executive functions and ToM, in addition to focusing on communication and emotional intimacy. Cognitive-behavioral interventions that target executive dysfunction, such as training in cognitive flexibility and inhibition, may help individuals better manage conflict and regulate emotions within their relationships.

Additionally, mindfulness-based interventions could be particularly beneficial for couples experiencing burnout. Mindfulness practices have been shown to improve both executive functions and social cognition, which are critical for effective communication and empathy in relationships. By enhancing emotional regulation and perspective-taking, mindfulness interventions may help couples reduce conflict, increase emotional intimacy, and ultimately prevent or alleviate marital burnout.

Finally, clinicians working with couples should be aware of the potential role that cognitive deficits play in relationship difficulties. Screening for executive dysfunction and ToM impairments during couples therapy could help identify underlying cognitive challenges that may be contributing to marital dissatisfaction. By addressing these cognitive deficits, clinicians can provide more targeted and effective interventions to improve relationship outcomes and reduce the risk of burnout.

Authors' Contributions

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All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the interview and participated in the research with informed consent.

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