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Predicting Visual and Auditory Memory in Adolescent Girls Based on Family Trauma

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A B S T R A C T

Purpose: The present study aimed to predict visual and auditory memory performance in adolescent girls based on different dimensions of family trauma.
Methods and Materials: This study employed a descriptive–correlational design with a predictive regression approach and was conducted as a field study among female students in the first cycle of secondary education in District 3 of Tehran. A sample of 384 participants was selected using multistage cluster sampling followed by convenience sampling based on inclusion criteria. Data were collected using the Childhood Trauma Questionnaire (CTQ) to assess emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect, the Corsi Block-Tapping Test administered via NCALab software to measure visual memory (forward and backward spans), and the Digit Span subtest of the Wechsler scales to assess auditory memory (forward and backward spans). Data collection was conducted individually in a controlled school environment after obtaining informed consent. Statistical analyses included Pearson correlation coefficients to examine relationships among variables and stepwise multiple regression analysis to determine the predictive power of trauma dimensions on memory performance using SPSS software.
Findings: The results revealed significant negative correlations between all dimensions of family trauma and both auditory and visual memory components ($p < .05$, $p < .01$). Emotional abuse and emotional neglect significantly predicted auditory forward memory, jointly explaining 22% of its variance ($R = 0.47$, $R^2 = 0.22$, $p < .001$), while emotional abuse showed a stronger predictive effect ($\beta = -0.32$, $p = 0.002$) compared to emotional neglect ($\beta = -0.21$, $p = 0.03$). Physical neglect emerged as the strongest predictor of visual forward memory, explaining 31% of its variance ($R = 0.55$, $R^2 = 0.31$, $p < .001$) with a substantial negative effect ($\beta = -0.56$, $p < .001$).
Conclusion: The findings indicate that family trauma, particularly emotional abuse, emotional neglect, and physical neglect, significantly impairs auditory and visual memory in adolescent girls, highlighting the importance of addressing adverse family experiences to support cognitive development and academic functioning.
Keywords: *family trauma, visual memory, auditory memory, adolescent girls, emotional abuse, neglect, working memory*

1. Introduction

Adolescence represents a critical developmental period characterized by profound neurobiological, cognitive, and socio-emotional transformations, during which individuals exhibit heightened sensitivity to environmental influences, particularly those rooted in family dynamics and early life experiences (Crone & Dahl, 2012). During this stage, the maturation of executive functions, including working memory, cognitive flexibility, and inhibitory control, plays a fundamental role in shaping academic performance, emotional regulation, and adaptive functioning. Among these cognitive processes, memory—especially visual and auditory working memory—serves as a central mechanism underlying learning, information processing, and goal-directed behavior (Lander et al., 2024; Studer et al., 2024). Visual memory enables individuals to encode, retain, and manipulate visuospatial information, whereas auditory memory facilitates the processing and recall of verbal and sequential information, both of which are essential for educational success and everyday functioning (Salemi et al., 2024). Consequently, identifying the factors that influence the development and functioning of these memory systems is of considerable importance in both educational psychology and clinical research.

One of the most significant environmental factors affecting cognitive development is exposure to family-related trauma during childhood and adolescence. Family trauma encompasses a broad spectrum of adverse experiences, including emotional, physical, and sexual abuse, as well as emotional and physical neglect, all of which can disrupt normative developmental trajectories (MacMillan, 2024). Extensive research has demonstrated that such adverse childhood experiences are not only associated with psychological and behavioral problems but also exert long-lasting effects on brain structure and function, particularly in regions involved in memory and executive functioning, such as the hippocampus and prefrontal cortex (Teicher & Samson, 2016). Neurobiological evidence suggests that chronic stress resulting from traumatic family environments can impair synaptic plasticity, alter neuroendocrine responses, and ultimately compromise cognitive capacities, including both auditory and visual memory processes (Hocking, 2021). These findings underscore the necessity of examining trauma not merely as a psychological phenomenon but as a factor with profound cognitive and neurodevelopmental implications.

In the context of family systems, various forms of dysfunction—including parental conflict, addiction, illness, and separation—have been identified as critical contributors to the emergence of trauma in children and adolescents. For instance, parental addiction has been linked to academic decline and emotional instability among students, reflecting the broader impact of maladaptive family environments on developmental outcomes (Ameri & Ghoraei, 2023; Shirini et al., 2023). Similarly, parental conflict and divorce have been associated with increased stress, anxiety, and cognitive difficulties, which may interfere with memory functioning and academic engagement (Pari et al., 2024; Zamani Pour, 2022). Other family-related stressors, such as chronic illness of parents or loss of a caregiver, further exacerbate these challenges by undermining emotional security and stability (Keikha, 2021; Mahdavi & Mir Sardo, 2002). From the perspective of attachment theory, early interactions with caregivers play a crucial role in shaping cognitive and emotional development, and disruptions in these relationships can lead to maladaptive internal working models that negatively affect memory and information processing (Hamz, 1999).

Empirical studies have consistently highlighted the relationship between childhood trauma and impairments in cognitive functioning, particularly in memory systems. For example, research has shown that individuals exposed to emotional abuse exhibit deficits in neuropsychological performance, including reduced working memory capacity and attentional control (Norouzi et al., 2015). Similarly, studies on autobiographical memory suggest that early traumatic experiences are associated with fragmented and less coherent memory representations, which may compromise overall cognitive efficiency and quality of life (Mohammadi et al., 2014). More recent investigations have extended these findings by demonstrating differential associations between specific types of trauma and distinct cognitive outcomes, indicating that not all trauma experiences exert uniform effects on memory systems (Wang et al., 2024; Zhang, 2025). For instance, neglect—particularly physical neglect—has been found to have a stronger association with deficits in visuospatial processing, whereas emotional abuse is more closely linked to impairments in verbal and auditory memory (Zhang et al., 2025). These nuanced findings highlight the importance of examining the multidimensional nature of trauma when investigating its cognitive consequences.

In addition to direct neurocognitive effects, trauma may also influence memory functioning indirectly through its

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impact on emotional regulation and psychological well-being. Trauma-exposed individuals often exhibit heightened levels of anxiety, depression, and emotional dysregulation, all of which can interfere with cognitive processes such as attention and memory encoding (Zahra & Ahmad, 2025). Emotional dysregulation, in particular, has been identified as a key mediator linking trauma to cognitive impairment, as it disrupts the allocation of cognitive resources necessary for effective information processing. Moreover, trauma-related stress can lead to increased cognitive load and intrusive thoughts, further reducing the efficiency of working memory systems. From an educational perspective, these cognitive disruptions manifest as difficulties in learning, reduced academic achievement, and increased risk of school dropout (Mottaghi et al., 2023; Sayehmiri et al., 2021). The interplay between emotional and cognitive factors underscores the complexity of trauma's impact on adolescent development.

The school environment has increasingly been recognized as a critical context for identifying and addressing the effects of trauma on cognitive and academic functioning. The concept of trauma-informed education emphasizes the need for educational systems to adopt strategies that support students affected by adverse experiences, including interventions aimed at enhancing memory and executive functioning (Perfect, 2019). Recent evidence suggests that targeted interventions, such as visual arts therapy and cognitive training programs, can mitigate the negative effects of trauma on memory and promote cognitive resilience (Maddox et al., 2024). Furthermore, strengthening protective factors such as resilience, adaptive coping strategies, and supportive relationships can buffer the impact of trauma and facilitate better cognitive outcomes (Mehrgan et al., 2022; Shafaghat, 2022). These findings highlight the importance of integrating psychological and educational approaches in addressing the needs of trauma-exposed adolescents.

Despite the growing body of research on trauma and cognitive functioning, there remains a need for context-specific studies that examine these relationships within diverse cultural and educational settings. In particular, research focusing on adolescent girls is of particular importance, as gender differences in emotional processing and vulnerability to trauma may result in distinct cognitive outcomes. Studies have shown that girls are more likely to experience internalizing problems, such as anxiety and depression, which can exacerbate the cognitive consequences of trauma (Fallahi Kia, 2021; Shams et al., 2021). Additionally, socio-cultural factors, including family expectations and gender roles, may influence both the experience of trauma and its impact on cognitive development. Therefore, investigating the relationship between family trauma and memory functioning in this population can provide valuable insights for both researchers and practitioners.

Moreover, contemporary research has increasingly emphasized the importance of adopting a multidimensional and integrative approach to understanding trauma and cognition. Advances in neuroscience, psychology, and educational sciences have highlighted the complexity of interactions between biological, psychological, and environmental factors in shaping cognitive outcomes (Stanton et al., 2025). Longitudinal studies have further demonstrated that the effects of childhood trauma can persist into adulthood, affecting not only cognitive functioning but also overall quality of life and psychosocial adjustment (Green & Myrick, 2014). These findings underscore the necessity of early identification and intervention to prevent the long-term consequences of trauma. By examining the predictive role of family trauma dimensions on specific cognitive outcomes such as visual and auditory memory, researchers can contribute to a more precise understanding of the mechanisms underlying these relationships and inform the development of targeted interventions.

In addition, recent global stressors have further highlighted the vulnerability of adolescents to family-related challenges and their cascading effects on cognitive and academic functioning. Increased family stress, economic pressure, and disruptions in daily routines have exacerbated the risk of trauma exposure, making it even more critical to investigate its impact on key cognitive processes (Zhang et al., 2025). Within this context, the integration of findings from diverse studies can enhance our understanding of how different types of trauma interact with developmental processes to influence memory functioning. This comprehensive perspective is essential for designing effective prevention and intervention strategies that address both the cognitive and emotional needs of adolescents.

Given the theoretical and empirical evidence highlighting the relationship between family trauma and cognitive functioning, particularly memory processes, it is essential to examine these associations in specific populations using rigorous methodological approaches. The present study, therefore, seeks to bridge existing gaps in the literature by focusing on adolescent girls and investigating the predictive role of different dimensions of family trauma on visual and auditory memory performance. Accordingly, the aim of this

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study is to predict visual and auditory memory in adolescent girls based on family trauma dimensions.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a descriptive–correlational research design using a predictive regression model to examine the relationship between family trauma and cognitive memory functioning. The research was conducted as a field study in selected educational centers. Within this framework, family trauma was operationalized as the independent (predictor) variable, while visual memory and auditory memory were defined as dependent (criterion) variables. The methodological approach was fully quantitative, involving the administration of standardized psychometric instruments and the application of inferential statistical analyses to determine the predictive power of the independent variable on the dependent variables in alignment with the study objectives.

The statistical population consisted of all female students enrolled in the first cycle of secondary education in District 3 of Tehran. The sample size was determined to be 384 participants based on Cochran's formula for large populations. A multistage cluster sampling method was employed for participant selection. In the first stage, three girls' schools were randomly selected from among the schools in the district. In the subsequent stage, participants were selected from among students in these schools using convenience sampling, based on predefined inclusion and exclusion criteria, until the required sample size was reached.

2.2. Measures

Data were collected using three primary instruments designed to assess the core constructs of the study. Family trauma was measured using the Childhood Trauma Questionnaire (CTQ), a 28-item self-report instrument that evaluates five dimensions of maltreatment, including emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect. This instrument is widely used in psychological research due to its established reliability and validity in assessing early adverse experiences.

Visual memory was assessed using the Corsi Block-Tapping Test, which was administered through the NCALab software environment. This test evaluates visuospatial short-term and working memory capacity by requiring participants to reproduce sequences of spatial locations. Both forward and backward span scores were recorded to capture different aspects of visual memory processing.

Auditory memory was measured using the Digit Span subtest from the Wechsler Intelligence and Memory Scales (WAIS/WMS). This subtest assesses the ability to recall and reproduce sequences of numbers and is considered a standard measure of auditory-verbal working memory. Participants were required to repeat sequences of digits in both forward and backward order, providing indices of attention, short-term memory, and working memory capacity.

The data collection procedure was carried out following the acquisition of official permissions from the Department of Education and the selected schools. Each participant was assessed individually in a quiet and controlled environment within the school setting. Prior to participation, written informed consent was obtained from all participants. The assessment process, which included completion of the CTQ and administration of the Corsi Block-Tapping and Digit Span tasks, took approximately 20 minutes per participant.

2.3. Data Analysis

The collected data were analyzed using statistical procedures appropriate for correlational and predictive research designs. Initially, Pearson correlation coefficients were computed to examine the relationships between family trauma dimensions and both visual and auditory memory performance. Subsequently, stepwise multiple regression analysis was conducted to determine the extent to which each dimension of family trauma contributed to the prediction of visual and auditory memory outcomes. This approach allowed for the identification of the most significant predictors among the trauma variables while controlling for shared variance among them. All statistical analyses were performed using SPSS software, and the level of significance was set according to conventional standards for behavioral research.

3. Findings and Results

The descriptive statistics presented in Table 1 indicate that among the memory variables, the highest mean score was observed in the auditory forward span (M = 6.23, SD = 1.34), while the lowest mean was associated with the auditory backward span (M = 4.64, SD = 1.17), suggesting comparatively greater difficulty in tasks requiring working memory manipulation. Visual memory scores demonstrated

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moderate central tendency, with forward (M = 5.78, SD = 1.61) and backward (M = 5.22, SD = 1.53) spans showing relatively similar distributions. Skewness and kurtosis indices for all memory variables fell within acceptable ranges, indicating approximate normality of distribution. Regarding trauma variables, emotional neglect exhibited the highest mean score (M = 12.81, SD = 4.27), whereas physical abuse showed the lowest mean (M = 9.40, SD = 4.07). The total trauma score had a mean of 56.63 (SD = 16.66), reflecting a moderate level of reported adverse experiences within the sample. The skewness values for trauma variables were generally positive, indicating slight rightward distributions, while kurtosis values were mostly negative, suggesting relatively flatter distributions compared to the normal curve. Overall, the distributional properties of all variables were within acceptable thresholds, supporting the suitability of the data for subsequent parametric analyses.

Table 1

Descriptive Statistics for Predictor and Criterion Variables

Variable	Minimum	Maximum	Mean (M)	Standard Deviation (SD)	Skewness	Kurtosis
Memory Variables						
Auditory Forward Span	2	9	6.23	1.34	-0.42	-0.11
Auditory Backward Span	2	9	4.64	1.17	0.29	0.35
Visual Forward Span	3	9	5.78	1.61	-0.09	-0.73
Visual Backward Span	3	9	5.22	1.53	-0.01	-0.70
Trauma Variables						
Emotional Abuse	5	21	10.92	4.49	0.43	-1.01
Physical Abuse	5	21	9.40	4.07	0.68	-0.31
Sexual Abuse	5	19	9.71	4.59	0.51	-1.38
Emotional Neglect	6	25	12.81	4.27	0.50	-0.35
Physical Neglect	5	20	11.28	4.26	0.34	-0.95
Total Trauma Score	39	100	56.63	16.66	0.34	-1.21

Prior to conducting the main analyses, the statistical assumptions underlying parametric tests were examined to ensure the validity of the results. The normality of the distribution for all study variables was assessed using skewness and kurtosis indices, which fell within acceptable ranges (±2), indicating no serious deviation from normality. Linearity between predictor variables (family trauma dimensions) and criterion variables (visual and auditory memory components) was evaluated through scatterplots, confirming a linear pattern of relationships. Homoscedasticity was also inspected, and the residual plots demonstrated a relatively constant variance across levels of the predictors. Independence of errors was verified using the Durbin–Watson statistic, which yielded values close to 2, suggesting no autocorrelation among residuals. Additionally, multicollinearity among predictor variables was assessed using tolerance and Variance Inflation Factor (VIF) indices; tolerance values were above 0.10 and VIF values were below 10, indicating that multicollinearity was not a concern. These findings collectively confirmed that the assumptions required for Pearson correlation and multiple regression analyses were adequately met.

Table 2

Pearson Correlation Matrix Between Trauma Dimensions and Memory Performance

Variables	1	2	3	4	5	6	7	8	9
1. Auditory Forward Span	1								
2. Auditory Backward Span	0.46**	1							
3. Visual Forward Span	0.44**	0.43**	1						
4. Visual Backward Span	0.35**	0.40**	0.46**	1					
5. Emotional Abuse	-0.42**	-0.34**	-0.38**	-0.42**	1				
6. Physical Abuse	-0.31**	-0.31**	-0.35**	-0.42**	0.70**	1			
7. Sexual Abuse	-0.20*	-0.26**	-0.22*	-0.26**	0.72**	0.68**	1		
8. Emotional Neglect	-0.36**	-0.33**	-0.43**	-0.27**	0.45**	0.65**	0.41**	1	
9. Physical Neglect	-0.38**	-0.31**	-0.55**	-0.52**	0.68**	0.69**	0.52**	0.62**	1

Note. *p < .05, **p < .01.

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The Pearson correlation matrix presented in Table 2 reveals a consistent and statistically significant pattern of relationships among the study variables. All components of memory performance were positively and significantly correlated with one another, with coefficients ranging from 0.35 to 0.46 ($p < .01$), indicating coherence among auditory and visual memory processes. In contrast, all dimensions of family trauma demonstrated significant negative correlations with memory variables, suggesting that higher levels of trauma are associated with poorer cognitive memory performance. Among these, physical neglect showed the strongest negative correlations with visual forward span ($r = -0.55$, $p < .01$) and visual backward span ($r = -0.52$, $p < .01$), indicating a particularly detrimental association with visuospatial memory functioning. Emotional abuse and emotional neglect also exhibited moderate negative correlations with both auditory and visual memory measures. Additionally, the trauma dimensions were positively and significantly intercorrelated with one another, with coefficients ranging from 0.41 to 0.72 ($p < .01$), reflecting substantial overlap among different forms of adverse experiences. Overall, the correlation pattern supports the theoretical expectation that family trauma is inversely related to both auditory and visual memory functioning in adolescent girls.

Table 3

Stepwise Regression Model Summary for Predicting Auditory Forward and Visual Forward Memory

Dependent Variable	Model	Predictors	R	R^2	Adjusted R^2	F	df1	df2	Sig.
Auditory Forward Span	1	Emotional Abuse	0.42	0.18	0.18	85.59	1	382	0.00
Auditory Forward Span	2	Emotional Abuse, Emotional Neglect	0.47	0.22	0.22	51.11	2	381	0.00
Visual Forward Span	1	Physical Neglect	0.55	0.31	0.31	174.08	1	382	0.000

The results of the stepwise multiple regression analyses presented in Table 3 indicate that different dimensions of family trauma significantly predict both auditory and visual memory performance. For auditory forward span, emotional abuse entered the model in the first step and accounted for 18% of the variance ($R = 0.42$, $R^2 = 0.18$, $F = 85.59$, $p < .001$), demonstrating a substantial predictive effect. In the second step, emotional neglect was added to the model, increasing the explained variance to 22% ($R = 0.47$, $R^2 = 0.22$, $F = 51.11$, $p < .001$), indicating that the combination of emotional abuse and emotional neglect provides a stronger prediction of auditory memory performance. Regarding visual forward span, physical neglect emerged as the sole significant predictor, explaining 31% of the variance ($R = 0.55$, $R^2 = 0.31$, $F = 174.08$, $p < .001$), which reflects a relatively strong predictive relationship. Overall, the findings suggest that specific dimensions of family trauma, particularly emotional and physical neglect, play a meaningful role in predicting deficits in both auditory and visual memory among adolescent girls.

Table 4

Regression Coefficients for Significant Predictors of Auditory Forward and Visual Forward Memory

Dependent Variable	Model	Variable	B	Std. Error	Beta (β)	t	Sig.
Auditory Forward Span	2	Constant	7.99	0.36	—	22.47	0.000
Auditory Forward Span	2	Emotional Abuse	-0.09	0.026	-0.32	-3.25	0.002
Auditory Forward Span	2	Emotional Neglect	-0.06	0.028	-0.21	-2.14	0.03
Visual Forward Span	1	Constant	8.66	0.38	—	22.78	0.000
Visual Forward Span	1	Physical Neglect	-0.21	0.16	-0.56	-13.19	0.000

The regression coefficients presented in Table 4 provide a more detailed understanding of the contribution of each significant predictor to memory performance. In the final model predicting auditory forward span, both emotional abuse and emotional neglect were found to be significant negative predictors. Specifically, emotional abuse demonstrated a stronger standardized effect ($\beta = -0.32$, $t = -3.25$, $p = 0.002$), indicating that higher levels of emotional abuse are associated with lower auditory memory performance. Emotional neglect also showed a significant negative effect ($\beta = -0.21$, $t = -2.14$, $p = 0.03$), although its predictive strength was comparatively weaker. For visual forward span, physical neglect emerged as a highly significant predictor with a strong negative standardized

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coefficient ($\beta = -0.56$, $t = -13.19$, $p < .001$), indicating that increased levels of physical neglect substantially reduce visual memory performance. The constant values in both models were also statistically significant, reflecting the baseline levels of memory performance when predictor variables are held constant. Overall, these results highlight the differential impact of specific trauma dimensions, with emotional factors more strongly influencing auditory memory and physical neglect exerting a pronounced effect on visual memory.

4. Discussion and Conclusion

The findings of the present study demonstrated that family trauma dimensions are significantly associated with both auditory and visual memory performance in adolescent girls, with all trauma components showing negative relationships with memory indices. Correlational analyses revealed that higher levels of emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect were consistently linked with lower performance in both forward and backward auditory and visual memory tasks. Among these, physical neglect exhibited the strongest negative association with visual memory indices, while emotional abuse and emotional neglect were more strongly related to auditory memory performance. Furthermore, stepwise regression analyses indicated that emotional abuse and emotional neglect jointly predicted auditory forward memory, accounting for a meaningful proportion of variance, whereas physical neglect emerged as the strongest and sole predictor of visual forward memory, explaining a substantial portion of its variance. These results suggest that family trauma not only broadly impairs cognitive functioning but also that specific subtypes of trauma differentially affect distinct memory systems.

The observed negative association between family trauma and memory performance is consistent with extensive neuropsychological and developmental research demonstrating that adverse childhood experiences disrupt cognitive processes, particularly working memory and executive functioning. Chronic exposure to stressors such as abuse and neglect is known to affect brain regions critical for memory, including the hippocampus and prefrontal cortex, leading to deficits in encoding, storage, and retrieval processes (Teicher & Samson, 2016). The findings of the present study align with systematic evidence indicating that children and adolescents exposed to trauma exhibit impairments in executive functioning and memory systems, as documented in comprehensive reviews of adverse childhood experiences and neurocognitive outcomes (Hocking, 2021). Moreover, research has shown that trauma-related neurobiological alterations may lead to reduced processing efficiency and increased cognitive load, thereby limiting the capacity of working memory systems to manage complex information.

The stronger predictive role of emotional abuse and emotional neglect in auditory memory performance may be explained by the close relationship between emotional experiences and verbal-cognitive processing systems. Auditory memory tasks, particularly those involving digit span, rely heavily on attentional control, verbal rehearsal, and sequential processing, which are highly sensitive to emotional dysregulation. Trauma-related emotional disturbances, such as heightened anxiety and intrusive thoughts, can interfere with the allocation of cognitive resources necessary for auditory information processing (Zahra & Ahmad, 2025). This interpretation is supported by findings indicating that emotional trauma is associated with impairments in verbal working memory and attentional control (Wang et al., 2024). Additionally, studies comparing abused and non-abused students have reported significant deficits in neuropsychological functioning, including memory performance, among those exposed to emotional maltreatment (Norouzi et al., 2015). These findings collectively suggest that emotional forms of trauma may exert a particularly detrimental effect on auditory memory systems through mechanisms involving emotional-cognitive interference.

In contrast, the prominent role of physical neglect in predicting visual memory performance highlights the importance of environmental stimulation and sensorimotor experiences in the development of visuospatial cognitive abilities. Visual memory, especially as measured by tasks such as the Corsi block-tapping test, depends on the integration of spatial processing, attention, and working memory. Physical neglect, which often involves deprivation of adequate environmental stimulation, supervision, and basic needs, may limit opportunities for cognitive engagement and exploration, thereby impairing the development of visuospatial skills. This finding is consistent with research indicating that neglect-related experiences are strongly associated with deficits in visuospatial processing and non-verbal cognitive functioning (Zhang, 2025). Furthermore, studies examining cognitive outcomes in trauma-exposed populations have reported that neglect, more than abuse, is linked to widespread cognitive

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impairments, including deficits in visual and spatial memory (Zhang et al., 2025). The strong negative beta coefficient observed in this study underscores the magnitude of this relationship and suggests that physical neglect may be one of the most critical risk factors for visual memory deficits in adolescents.

The intercorrelations observed among trauma dimensions further support the perspective that different forms of adverse experiences often co-occur and interact to influence cognitive outcomes. High correlations between emotional abuse, physical abuse, and neglect dimensions indicate that adolescents exposed to one form of trauma are likely to experience others, resulting in cumulative and compounding effects on cognitive functioning. This pattern is consistent with the cumulative risk framework, which posits that the accumulation of multiple adverse experiences leads to greater developmental disruptions than any single factor alone (MacMillan, 2024). In this context, the combined predictive effect of emotional abuse and emotional neglect on auditory memory can be interpreted as reflecting the synergistic impact of multiple trauma dimensions on cognitive systems. Such cumulative effects have been widely documented in the literature on adverse childhood experiences and their long-term consequences (Teicher & Samson, 2016).

From a developmental perspective, the findings of this study are particularly significant given the sensitivity of adolescence as a period of rapid cognitive and emotional maturation. During this stage, the brain undergoes extensive structural and functional changes, particularly in regions associated with executive functioning and memory (Crone & Dahl, 2012). Exposure to trauma during this critical developmental window may disrupt these processes, leading to enduring cognitive impairments. The results of the present study are consistent with developmental models suggesting that early adverse experiences can alter developmental trajectories and compromise the maturation of cognitive systems (Green & Myrick, 2014). Additionally, the association between family dysfunction and academic difficulties observed in previous research further supports the link between trauma and cognitive functioning, as memory deficits can directly affect learning and academic achievement (Ameri & Ghoraei, 2023; Mottaghi et al., 2023).

The findings also have important implications for understanding the role of family context in shaping cognitive outcomes. Family-related stressors such as parental conflict, addiction, and separation have been shown to negatively impact children's psychological and academic functioning (Pari et al., 2024; Zamani Pour, 2022). These stressors may contribute to the development of trauma and, consequently, to impairments in memory and other cognitive processes. The results of this study extend this line of research by demonstrating that these family-related adversities are not only associated with emotional and behavioral outcomes but also with specific cognitive deficits. Moreover, the role of attachment disruptions in mediating the relationship between family trauma and cognitive functioning should be considered, as insecure attachment patterns have been linked to difficulties in attention, memory, and information processing (Hamz, 1999).

In addition to direct cognitive effects, the relationship between trauma and memory may be mediated by factors such as psychological resilience, coping strategies, and emotional regulation. Studies have shown that individuals with higher levels of resilience are better able to cope with stress and maintain cognitive functioning despite exposure to adversity (Mehrgan et al., 2022). Conversely, maladaptive coping strategies and poor emotional regulation can exacerbate the negative impact of trauma on cognitive processes (Shafaghat, 2022). These findings suggest that interventions aimed at enhancing resilience and adaptive coping may help mitigate the cognitive consequences of trauma. Furthermore, trauma-informed educational approaches, which emphasize the creation of supportive and responsive learning environments, may play a crucial role in addressing the needs of trauma-exposed students and improving their cognitive outcomes (Perfect, 2019).

The present study also contributes to the growing body of research emphasizing the importance of domain-specific analysis of cognitive outcomes. Rather than treating memory as a unitary construct, the differentiation between auditory and visual memory allows for a more nuanced understanding of how different trauma dimensions affect specific cognitive systems. This approach is consistent with recent research highlighting the differential effects of trauma subtypes on distinct neurocognitive functions (Lander et al., 2024; Studer et al., 2024). By identifying the specific trauma dimensions that most strongly predict different types of memory performance, the study provides valuable insights for the development of targeted interventions and prevention strategies.

Authors' Contributions

All authors significantly contributed to this study.

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Declaration

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

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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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 study and participated in the research with informed consent.

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