

# Mediation role of alexithymia, sensory processing sensitivity and emotional-mental processes between childhood trauma and adult psychopathology: a self-report study

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## Research Article

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## Abstract

## Background

There is overwhelming evidence for a strong association between childhood trauma and adult psychopathology. This study aims to investigate the mediation roles of alexithymia, sensory processing sensitivity, and emotional-mental processes in the relationship between childhood traumas and adult psychopathology.

## Methods

337 people (78.9% female, 21.1% male) between the ages of 20–64 participated in this study. Participants filled the scales online via google form. Reading Mind in the Eyes (EYES), Sensory Processing Sensitivity Scale (SPS), Toronto Alexithymia Scale (TAS-26), Childhood Trauma Questionnaire (CTQ), and the Brief Symptom Inventory (BSI) were used. SPSS Process (Model 4) was used to examine the mediating role of sensory processing sensitivity, alexithymia and the eyes test results in the relationship between childhood trauma and psychopathology.

## Results

Sensory processing sensitivity and alexithymia have been found to mediate the relationship between childhood trauma and adult psychopathology. The eyes test (mentalization) was not found to have a mediating effect on this relationship.

## Conclusion

This study shows that childhood traumas may relate more psychopathology in individuals with high sensory processing sensitivity and alexithymia. Our study may contribute to the understanding of what may lead to a person's vulnerability to experiencing psychopathology after childhood trauma. It may be important that future treatment and intervention programs should include sensory sensitivity and alexithymia. Sensory processing sensitivity and alexithymic characteristics of individuals can be examined in the treatment of psychological problems of individuals who have experienced childhood trauma.

## Introduction

Childhood trauma is defined as a psychological consequence of sudden or ongoing external blows that temporarily leave the child helpless, damage coping mechanisms, or a series of ongoing external injuries (1). Bernstein and Fink (2) proposed a definition that includes child abuse and neglect, which includes verbal attacks on a child's sense of self-worth, bodily attacks that pose a risk of injury, sexual contact with a child, failure to provide basic psychological and emotional needs, and failure to meet basic needs. Terr (1) emphasized that 4 features are important in traumatized children regardless of their age. These were expressed as visualized or repeatedly perceived memories, repetitive behaviors, fears associated with trauma, changing attitudes about people, life and the future. There is broad evidence that childhood trauma and different subtypes are frequent in various populations. In a study conducted with a German sample, 2510 participants aged 14–94 completed the Child Trauma Questionnaire (CTQ); as a result, 2.6% of the participants stated that they were subjected to severe emotional abuse, 3.3% physical abuse, 2.3% sexual abuse, 7.1% emotional neglect, and 9% physical neglect (3). In the meta-analysis study where the prevalence of physical and emotional neglect was examined, it was pointed out that physical neglect based on self-report was 16.3%, emotional neglect was 18.4% (4). In a meta-analysis study that examined 217 studies published between 1982 and 2008, it was concluded that 118 out of 1000 children were exposed to sexual abuse. Another meta-analysis study including studies conducted in 22 countries on the prevalence of childhood sexual abuse showed that 7.9% of men and 19.7% of female were exposed to sexual abuse before the age of 18 (5). This situation reveals that sexual abuse is a universal problem (6). In another study conducted with students of the Faculty of Medicine (n = 192), 32.3% of the students stated that they experienced emotional abuse, 14.6% physical abuse, and 8.9% sexual abuse (7).

The knowledge of childhood trauma and other forms of violence is difficult to access due to social taboos, studies show that traumatic childhood experiences are common (8). In addition to the prevalence of this condition, traumatic childhood experiences have developmental and long-term effects in many areas of functionality (8). Childhood traumas can interrupt developmental processes and lead to neurological, physiological and psychological consequences (9). Adults who experienced childhood trauma developed many psychopathologies in life. Most of the adults suffering from mood disorders (10, 11, 12, 13, 14, 15) and anxiety disorders (16, 17, 18, 19) experience trauma during childhood. Childhood trauma increases the likelihood of post-traumatic stress disorder (PTSD) (11, 20), obsessive-compulsive disorder (21), personality disorders (22, 23, 19), psychotic symptoms (24). Individuals with childhood trauma have higher risk of suicide, suicide probability, suicide attempts and self-harming behaviors (25, 26, 27, 28). Childhood trauma appears to have a significant impact on the emergence of many psychological disorders, including the risk of suicide. Also, childhood trauma negatively affects alcohol and substance abuse in adulthood (11, 19). In addition to these, traumatic experiences in childhood are also closely related to physical symptoms such as chronic fatigue (29), pain disorders (30), sleep problems (31) and cognitive impairment (32) in adulthood.

There are various theories explaining the development of psychopathology in individuals who experience childhood trauma. One of these is the hypothalamic-pituitary-adrenal axis (HPA). Stress is defined as stimuli or experiences that cause negative emotional reactions or feelings such as fear and loss of control. Maltreatment from parents in early childhood is one of the most important sources of stress (33). The HPA axis, sympathetic nervous system and immune system play an important role in the stress response (33). Traumatic events in childhood cause damage to the neurobiological and neuroendocrine system, which significantly affects social, emotional and cognitive development (34). For example, childhood maltreatment causes disruptions in the HPA axis, which is an important factor in the development of psychological disorders (35, 36, 37).

Exposure to trauma in childhood and infancy is associated with dysfunction in the HPA axis (38, 39, 40). Irregularity caused by childhood trauma in the HPA axis affects suicidal behavior in adulthood (41). When danger is perceived, corticotropin releasing factor is released from the hypothalamus. In this case, the pituitary gland is stimulated and cortisol release from the adrenal glands begins. The release of cortisol causes anxiety symptoms such as an increase in heartbeat and increased blood pressure. Exposure to stress for a long time causes a continuous release of cortisol, which affects learning, memory and other cognitive functions (42). Exposure to trauma in childhood causes shrinkage in the brain. This has important effects on psychopathology such as impulse control and inability to regulate emotions (43). In a study with young people exposed to different types of childhood trauma, it was stated that fast or slow HPA reactivity increased internalization and externalization symptoms (36). Early and chronic adversities are associated with more hypocortisolism patterns (44). As a result of child maltreatment, significant changes occur in brain functions. As can be seen, most of these changes are related to the stress response. In addition, these changes in the brain cause aggressive responses and problems in executive functions (33). Brain structures affected by the secretion of chronic stress hormones in childhood are differently involved in various cognitive functions such as memory and emotion regulation (45).

Impairments in the HPA axis are determined by changes in cortisol levels (46, 36, 47). In the literature, alexithymia, sensory sensitivity, and emotion recognition skills are related to cortisol. Studies indicate that alexithymia is associated with elevated cortisol levels (48, 49, 50). Similarly, high cortisol levels appear to be associated with sensitivity in sensory processing (51). The relationship between the ability to recognize emotions and cortisol level is different. Although some studies indicate that individuals who are good at recognizing emotions have high cortisol levels (52), some do not report a relationship between emotion recognition and cortisol levels (53). Considering the concept of trauma on the HPA axis, it is thought that trauma causes a significant deterioration in cognitive, executive functions, emotional skills, and sensitivity to stress, and this relates possible pathways to psychopathology. Therefore, it was thought that the possible mediators of childhood trauma to cause psychological distress might be emotional and mental processes (EYES test), alexithymia associated with skills in understanding and expressing emotions, and sensory processing sensitivity associated with sensitivity to stimuli.

The concept of alexithymia is a concept introduced by Sifneos and it means that there is no word for emotions (54). Alexithymic individuals have difficulty in defining their own emotions, and their thinking styles are impoverished in terms of imagination, reality-based and embodied (55). It was found that individuals with childhood trauma had higher alexithymia levels (56, 57, 58). In addition, studies show that individuals with high levels of alexithymia also develop more psychological symptoms (59, 60).

The term mentalizing, one of the cognitive and emotional functions, refers to the process in which inferences are made about mental states. People's faces become an important resource for inference (61). Children with trauma have difficulties in understanding and recognizing emotions from facial expressions (62, 63, 64). In addition, studies reveal that people with psychological symptoms in adulthood have difficulty recognizing emotions from facial expressions (65, 66, 67).

Sensory processing sensitivity, thought to be another possible mediator variable, is a term introduced by Aron and Aron (68) that defines the sensitivity of the individual to the perception of social and emotional stimuli against internal and external stimuli. For example, the individual is sensitive to sensations such as pain, hunger, and stimuli such as loud sounds and sharp odors. The fact that the individual perceives and interprets such stimuli faster and responds faster to these stimuli indicates that the individual has a high sensitivity to sensory processing. There are findings in the literature that individuals with childhood trauma decrease in pain threshold and increase in sensitivity towards stimuli in adulthood (69, 70, 71). Individuals with increased sensitivity to stimuli and high level of sensory processing sensitivity are at increased risk of developing various psychological problems (72, 73).

Although there are studies supporting the relationship between childhood trauma and psychological distress in the literature, that similar concepts are studied in mediation models that have been created. It has been observed that the relationship between alexithymia and childhood trauma and psychopathology has been studied extensively. However, the number of studies involving sensory processing sensitivity and emotional mental processes is limited. In this context, this study aims to present up-to-date and comprehensive information to the literature by considering all these variables together. It is predicted that the findings of the study may serve to understand the predisposing factors in the relationship between childhood trauma and psychopathology. In this context, our study has a hypothesis. Our hypothesis claims that emotional-mental processes, sensory processing sensitivity and alexithymia mediates the relationship between childhood traumatic experiences on adult psychopathology.

## Methods

### Participants

In this study, firstly, 374 people between the ages of 20–64 were reached by convenience sampling. The data collection process has been completed through the surveys shared via google form. The data of the participants who were not in the age range we indicated and did not fill almost all of a scale were not included in the analysis. There were no missing answers in the scales filled in via the online google form. However, data from some participants were collected by hand. It was observed that the participants who answered the questions by hand did not complete some scales at all. Therefore, the information of the participants whose data was collected by hand were not included in the analysis. Only online data were evaluated.

At the last stage, 337 people aged between 20–64 ( $M=29.89$ ,  $SD=10.53$ ) were included in the analysis. 78.9% ( $N=266$ ) of the participants are female and 21.1% ( $N=71$ ) are male. Most of the participants are university graduates ( $N=320$ , 95%). Most of the participants stated their perceived socio-economic levels as moderate ( $N=198$ , 58.8%) and good ( $N=111$ , 32.9%). 95% of the participants ( $N=320$ ) were university graduates, 4.2% ( $N=14$ ) were high school graduates, 6% ( $N=2$ ) were secondary school graduates, and 3% ( $N=1$ ) were primary school graduates. 58.8% ( $N=198$ ) of the participants had medium perceived income level, 32.9% ( $N=111$ ) good, 6.2% ( $N=21$ ) bad, 1.5% ( $N=5$ ) as very good and 0.6% ( $N=2$ ) as very bad.

### Instruments

## Demographic Information Form

The demographic information form contains questions about age, gender, education, and socioeconomic levels.

## Emotional and Mental Processes

Reading mind in the eyes test (EYES) developed by Baron-Cohen and his colleagues (74) was used to evaluate emotional and mental processes. Participants are shown a black and white photograph of eyes and that the four options are emotion words, with one word best describing the emotion displayed in the photograph. There are four options, one correct answer and three distractions for each image. The Turkish version of the test consists of 32 questions. The reliability results of the test with Kuder – Richardson 20 were found as  $KR20 = 0.72$  (75). In this study, Cronbach's alpha value was found 0.47. The high score obtained from the scale shows the person's high-level ability to recognize emotions and expressions by looking at the eyes.

## Sensory Processing Sensitivity Scale

The Sensory Processing Sensitivity Scale (SPS) (A highly sensitive person scale) developed by Aron and Aron (68) was used to measure individuals' differences in processing both internal (e.g., pain, hunger) and external (e.g., art, noise, emotional states of others) stimulus. This scale consisting of 27 items is scored in the 1–7-point likert type. In the Turkish version of the sensory processing sensitivity scale, the scale was found to have a four-factor psychometric structure with high internal consistency (76). These four factors are called Overstimulation Sensitivity, External Stimulus Sensitivity, Aesthetic Sensitivity, Harm Avoidance. In this study, Cronbach alpha values of the subscales of the scale were found as 0.83 for Overstimulation Sensitivity, 0.88 for External Stimulus Sensitivity, 0.58 for Aesthetic Sensitivity, and 0.44 for Harm Avoidance. High scores obtained from the scale indicate high level sensory processing sensitivity. The Cronbach alpha value for all items of the scale is 0.87.

## Alexithymia

Toronto Alexithymia Scale (TAS-26) was used to measure the level of alexithymia. The Toronto Alexithymia Scale was developed by Taylor and his colleagues (55). This scale, consisting of 26 items, is a likert scale between 1–5 and consists of 4 subscales. In the Turkish validity study conducted by Motan and Gençöz (77), it was observed that the items of the scale were collected in 3 factors. Factors were named as Difficulty in Emotional Communication, Difficulty in Recognizing and Defining Emotions, Lack of Imagination. The internal consistency coefficients of the dimensions of Difficulty in Emotional Communication, Difficulty in Recognizing and Defining Emotions, Lack of Imagination were found as 0.82, 0.80, 0.75, respectively. In this study, the Cronbach alpha values of the subscales were found as 0.71 for Difficulty in Recognizing and Defining emotions, 0.61 for Difficulty in Emotion Communication, and 0.69 for Lack of Imagination. The high score obtained from the scale indicates high level alexithymia. The Cronbach alpha value for all items of the scale is 0.80.

## Childhood Trauma

Childhood Trauma Questionnaire (CTQ), developed by Bernstein and his colleagues (2), was used to evaluate childhood traumas. The questionnaire, adapted to Turkish by Şar and his colleagues (78), has subscales of sexual, physical, emotional abuse and physical and emotional neglect. The scoring of the scale, which evaluates the abuse and neglect experiences before the age of 20 based on self-report, is 5-point Likert type. In the study on the reliability and validity of the Turkish version of the scale, the correlation coefficients for the subscales of the questionnaire were found as 0.73 for sexual abuse, 0.90 for physical abuse, 0.90 for emotional abuse, 0.77 for physical neglect, and 0.85 for emotional neglect, respectively (78). In this study, Cronbach alpha values for the subscales of the questionnaire were found as 0.92 for sexual abuse, 0.94 for physical abuse, 0.83 for emotional abuse, 0.64 for physical neglect, and 0.89 for emotional neglect, respectively. High scores from the scale indicate the excess of traumatic life in childhood. The Cronbach alpha value for all items of the scale is 0.91.

## Psychopathology

Brief Symptom Inventory (BSI) was originally developed by Deretogis (79). It consists of 53 items and is based on self-report. It was used to evaluate psychopathology. In the Turkish adaptation study by Şahin and Durak (80), subscales were named as depression, anxiety, negative self, somatization and hostility. The Cronbach alpha values obtained for the subscales ranged between 0.63 and 0.86. Cronbach alpha values of the brief symptom inventory subscales for this study were found as 0.89 for anxiety, 0.92 for depression, 0.90 for negative self, 0.85 for somatization, 0.83 for hostility. High scores from the scale indicate the excess of psychopathology. The Cronbach alpha value for all items of the scale is 0.97.

## Procedure

Ethical approval was given to the study by the Ankara University Human Research Ethics Committee. Necessary permissions were obtained from the researchers who adapted the scales to Turkish for the use of the scales. All data (N = 337) was obtained through an online questionnaire. Google Form was used for online data collection. Participants in the study are expected to read and approve the informed consent form before viewing the questions. At the end of the informed consent form, there is the statement "I have read the statement and voluntarily participate in this research". There is a tick box to the left of this statement, and after confirming the tick box, the participants were able to see the questions. They participated voluntarily and were not given an incentive or reward for participating in the study. When participants wanted to leave the study, they had the right to leave without any pressure at any stage of the study. Each scale was presented to the participants in the same order. It took approximately 50 minutes to respond to the scale items. It was mandatory to answer all questions in Google form. In this way, the participants who did not answer all the questions could not complete the questionnaire.

## Data Analysis

Statistical analyses were carried out with Statistical Package for Social Sciences – SPSS, version 21.00. It was used to conduct descriptive analysis (age, gender, education) and comparison of mean scores CTQ and BSI. Second, gender variable was controlled and the relationship between the total scores of the scales was examined. It was added as a gender control variable and the Bootstrap method with 1000 samples was applied via the SPSS process. Third, SPSS

Process (Model 4) was used to examine the mediating role of sensory processing sensitivity, alexithymia and the eyes test results in the relationship between childhood trauma and psychopathology (81).

## Results

The subscales of Childhood Trauma Questionnaire and Brief Symptom Inventory scale were examined in terms of demographic variables (gender, education, perceived socio-economic level). Depression and somatization, which are subscales of Brief Symptom Inventory, differ only by gender. Except for gender, there is no difference between demographic variables and subscales. Depression scores of females are higher than male  $t(335) = 2.70, p < .01$ . Somatization scores of females are higher than male  $t(335) = 2.28, p < .01$ .

The relationships between the total scores obtained from all scales and demographic variables were examined with One-Way ANOVA and T-test. There is no significant difference between the total scores of all scales according to education level and perceived socio-economic level. There are significant differences in some of the total scores of the scales only by gender. Table 1 shows that sensory processing sensitivity and eyes test results differ significantly by gender.

Table 1

Descriptive statistics and t values according to gender					
	Gender				
	Female (N= 266)		Male (N= 71)		
	M	SD	M	SD	
CTQ	39.43	14.75	39.86	16.34	-0.21
TAS-26	59.59	12.66	58.34	14.32	0.72
SPS	128.25	21.03	119.22	19.03	3.27***
EYES	24.43	2.95	23.22	3.71	2.89**
BSI	119.47	41.82	109.84	42.30	1.72

Note 1. BSI = Brief Symptom Inventory, SPS = Sensory Processing Sensitivity Scale, TAS-26 = Toronto Alexithymia Scale, CTQ = Childhood Trauma Questionnaire, EYES = Reading Mind in The Eyes Test

Note 2. \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ .

## Partial Correlations Between All Variables

Considering that gender may be a confounding variable, the effect of gender in correlation analysis was controlled. CTQ, SPS, BSI, TAS-26 total scores are positively associated with each other. Table 2 shows that the Eyes test results do not correlate with the CTQ, SPS, BSI, TAS-26 results.

Table 2

Partial Correlations Between All Variables					
	CTQ	TAS-26	SPS	EYES	BSI
CTQ	—				
TAS-26	0.33***	—			
SPS	0.24***	0.20***	—		
EYES	-0.08	-0.09	0.05	—	
BSI	0.05***	0.57***	0.47***	0.04	—

Note 1. BSI = Brief Symptom Inventory, SPS = Sensory Processing Sensitivity Scale, TAS-26 = Toronto Alexithymia Scale, CTQ = Childhood Trauma Questionnaire, EYES = Reading Mind in The Eyes Test

Note 2. \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ .

Note 3. The results were obtained after controlling for the effect of the gender variable.

### Mediating Role of Sensory Processing Sensitivity, Alexithymia, Emotional-Mental Processes (EYES) in the Relationship Between Childhood Trauma and Psychopathology

Mediation analysis was performed to examine the possible mediator roles of sensory processing sensitivity, alexithymia and eyes test results in the relationship between childhood trauma and psychopathology by controlling the gender variable (see Fig. 1).

Childhood trauma is positively associated with alexithymia ( $\beta = 0.28, t = 6.34, p < .001, 95\% \text{ CI } [0.20, 0.37]$ ). Childhood trauma is positively associated with sensory processing sensitivity ( $\beta = 0.33, t = 4.59, p < .001, 95\% \text{ CI } [0.19, 0.48]$ ). Childhood trauma is not associated with the eyes test ( $\beta = -0.02, t = -1.49, p = .14$ ).

95% CI [-.04, 0.01]).

Alexithymia is positively associated with psychopathology ( $\beta = 1.41, t = 10.65, p < .001, 95\% \text{ CI } [1.15, 1.67]$ ). Sensory processing sensitivity is positively associated with psychopathology ( $\beta = 0.65, t = 7.92, p < .001, 95\% \text{ CI } [0.49, 0.81]$ ). The eyes test is positively associated with psychopathology ( $\beta = 1.14, t = 2.19, p < .05, 95\% \text{ CI } [0.11, 2.17]$ ).

According to the results, the indirect effects of both alexithymia ( $b = 0.40, \text{boot SE} = 0.07, 95\% \text{ CI } [0.25, 0.54]$ ) and sensory processing sensitivity ( $b = 0.22, \text{boot SE} = 0.05, 95\% \text{ CI } [0.13, 0.32]$ ) on the relationship between childhood trauma and psychopathology are significant. The indirect effect of the eyes test on the relationship between childhood trauma and psychopathology is not significant ( $b = -0.02, \text{boot SE} = 0.02, 95\% \text{ CI } [-0.06, 0.01]$ ). Accordingly, sensory processing sensitivity and alexithymia mediate the relationship between childhood trauma and psychopathology.

The direct effect of childhood trauma on psychopathology was found as  $.65 (\beta = 0.65, t = 5.65, p < .001, 95\% \text{ CI } [0.43, 0.88])$ , and the indirect effect as  $1.25 (\beta = 1.25, t = 9.20, p < .001, 95\% \text{ CI } [0.98, 1.52])$ . When looking at the whole model, the model is significant and explains 51% of the variance ( $R^2 = 0.51, F(5, 331) = 70.01, p < .001$ ).

## Discussion

In this study, variables that are thought to mediate the effect of childhood trauma on psychopathology were examined. Childhood trauma had a positive predictive effect on psychopathology, and the sensory processing sensitivity and alexithymia had a mediating role in this effect.

According to the literature, childhood traumas can be a predisposition or risk factor for different psychopathology. In this study, the relationship between childhood traumas and psychopathology was supported, and it was seen that the two variables mediating this relationship were sensory processing sensitivity and alexithymia. The mediating role of sensory processing sensitivity for the relationship between childhood trauma and psychopathology was found to be significant. Findings demonstrate that the relationship between childhood trauma, sensory processing sensitivity and psychopathology is consistent with the relevant literature (82, 72, 83, 84). Although there is no study on the mediating role of sensory processing sensitivity in this relationship, Aron, Aron and Davis (82) point out that individuals with a high level of sensitivity who have a negative childhood experience have a higher tendency to be shy and express negative affect. Also, Aron, Aron, and Jagiellowicz (85) stated that children with high levels of sensitivity in their childhood are highly reactive to positive and negative events. While a childhood environment, negative or traumatic experience may increase the individual's sensitivity to sensory processing, individuals with a high level of processing sensitivity with childhood trauma may develop a tendency to experience psychological distress. Therefore, longitudinal studies are needed to explain the nature of this relationship. In addition, fMRI studies have supported that some disorders with overlapping features in the clinical context may differ in sensory processing sensitivity (86). In this respect, studies on the differences in sensory processing sensitivity based on psychological problems can be carried out.

Looking at the role of alexithymia, alexithymia mediates the relationship between childhood trauma and psychopathology. Studies show that alexithymia is associated with childhood trauma (87, 88, 89, 90). In a study comparing alexithymia and early life stresses in healthy samples with low and high alexithymia levels, a positive correlation was found between early emotional neglect and alexithymia (56). In a study that looked at the relationship between posttraumatic stress disorder (PTSD) and alexithymia, high level alexithymia was associated with childhood traumas (emotional and physical neglect) (91). Studies show that alexithymia is positively associated with psychopathology (87, 92, 93). For example, studies examining the relationship between depression and anxiety and alexithymia reveal that high-level depression and anxiety are associated with high-level alexithymia (94, 95, 96). There are many studies that reveal or try to explain that alexithymia has a mediating role in the relationship between childhood trauma and psychopathology. Childhood trauma contributes to physical and mental outcomes in adulthood through alexithymia (87). Zou and his colleagues (93) emphasized that alexithymia mediates the relationship between certain types of childhood trauma and the severity of panic disorder. The presence of low expressions of the S or Lg allele of the 5-HTTLPR gene in individuals with childhood trauma was found to be associated with higher levels of alexithymia (97). It is noteworthy that these genes (97) and alexithymia (88) are also associated with emotion regulation. From this point of view, it will be important to study emotion regulation difficulty in future studies. Considering that alexithymia is associated with both childhood trauma and psychopathology, it is thought that the level of alexithymia may be a risk factor or a predisposition factor.

In the mediation analysis although the eyes test is not associated with childhood trauma, it is positively associated with psychopathology. However, although in the mediation analysis the eyes test is positively associated with psychopathology, the indirect effect of the eyes test on the relationship between childhood trauma and psychopathology is not significant. Accordingly, the eyes test results did not mediate the relationship between childhood trauma and psychopathology. Although rare, there are studies showing that childhood trauma and mentalization skills are not related (98). Mostly, studies show that childhood trauma is negatively related to mentalization skills (99, 65, 100, 101) and mentalization skills to psychopathology (99, 101). In addition, research shows that mentalization skills mediate between childhood trauma and psychopathology (99, 102). Many factors may have affected the results of the eyes test in this study. The mean of the participants' age in this study is 30.65, 93% are university graduates, 78.4% are females and perceived socio-economic levels are above and below. Studies indicate that females are better at recognizing emotions than male and young people compared to older individuals and individuals have experienced a decrease in emotion recognition skills from the age of 30 (103, 104). Predominantly young and female participants' profile in our study may be a factor in explaining the weak relationship between the eyes test and psychopathology. It is considered that the participants having the high level of education can have better emotional and mental skills. In partial correlation (gender controlled) analysis the eyes test was not associated with psychopathology. Clinical groups and clinically high-risk groups show much lower emotion recognition performance compared to healthy control groups (105, 106). In this study, the participants do not represent a clinical sample. Finally, it was thought that low reliability coefficient ( $\alpha = .47$ ) of the test may be a factor in the absence of expected relationships between reading mind in the eyes test, alexithymia and psychopathology.

The current limitations of the study were sampling features and features of measurement tools. Although the sample size seems sufficient, the demographic characteristics of the participants are similar in terms of education and age. Most of the participants are composed of individuals who are young and higher education levels. It is suggested to include different groups in terms of education and age in later studies. Additionally, the limited number of participants negatively affects the generalizability of the study results. The data in this study are based on self-reports of individuals, although the confidentiality of the data is preserved, individuals may have difficulties in answering questions that may be difficult for them (e.g., childhood trauma scale). The high number of items in the scales we used in the study may have caused reluctance for participants to respond or may have caused random responses. Therefore, it seems more convenient that the scales that will be used in the next studies are shorter and advantageous in time. In addition to self-report based measurement tools, objective measurement tools and experimental methods can be used. Also, people may misremember retrospective childhood trauma, and may be affected by their current emotional state in these recall situations. This situation may create limitations on the basis of retrospective data. The Cronbach Alpha value of the brief symptom inventory among the scales used in the study was found to be 0.97. Cronbach alpha values of 0.58–0.97 are considered satisfactory. When there are reliability values close to 1, it requires careful use of the scale in the future (107). This study is a cross-sectional study; therefore, it only provides information about the time the data was collected. Obtaining wide-ranging findings with longitudinal studies will be more effective in examining childhood trauma. Studies that follow-up from childhood or adolescence to adulthood may be important in order to better understand the effects of childhood trauma. Differences in psychopathology of people who were exposed to childhood trauma and those who did not can be tested in subsequent studies. Since the study is also a correlational study, it is not possible to establish a cause-effect relationship between concepts. Another important limitation of this study was that the scales were always presented in the same order. Results may have been affected due to the order in which the scales were presented. It is recommended to pay attention to this in future studies. The childhood trauma scale was the last scale presented. Participants may feel negative emotions after completing this scale. To prevent this, researchers could use a scale with a more positive ending. As another option, participants could be asked to contact researchers when they are uncomfortable. There should have been more ethical precautions for this study.

As a result, although this study has certain limitations, too many scales have been studied with a good number of samples. It suggests that we contribute to a limited literature by working on sensory processing sensitivity and reading mind in the eyes test. The study model we have established, and results showed that sensory processing sensitivity and alexithymia play a role in the relationship between childhood traumas and psychopathology. Our study may contribute to the understanding of what may lead to a person's vulnerability to experiencing psychopathology after childhood trauma. Since the model we have established is a mediation model, it cannot give us information about the nature of this relationship. As a clinical perspective, it is recommended to conduct prospective longitudinal follow-up studies in order to test the model we have established in adolescents and young adults with trauma. Comparisons based on measurement of HPA activity in adults exposed to childhood trauma (neuroendocrine variables, cortisol level, etc.) and associations with psychopathology may contribute to the literature. When childhood trauma is evaluated in future studies, it is recommended to consider the neuroendocrine variables of the participants in cooperation with different disciplines. Genetically, if the HPA axis has a less responsive structure, this situation is protective in the effect of early negative life events on emotion recognition (108). Also, studies on the relationship of early childhood parental care with the HPA axis indicate that sensitive and responsive care and secure attachment are buffers for the HPA axis (38). In future studies, the examination of genetic factors and different protective factors may contribute to the clarity of the study.

## Conclusion

The extent to which childhood trauma affects psychological health in adulthood is frequently examined today and the importance of intervening in childhood trauma is emphasized. For this reason, it is important to examine in detail the strong relationship between childhood trauma and psychopathology and to understand which areas and how to intervene. Sensory processing sensitivity and alexithymic characteristics of individuals can be examined in the treatment of psychological problems of individuals who have experienced childhood trauma. Investigation of these features and development of intervention programs for individuals with childhood trauma enable more comprehensive prevention and intervention programs in terms of psychopathology that may arise in the future.

## Abbreviations

BSI: Brief Symptom Inventory; CTQ: Childhood Trauma Questionnaire; EYES: Reading mind in the eyes test; HPA: Hypothalamic-pituitary-adrenal axis; PTSD: Post-traumatic stress disorder; SPS: Sensory Processing Sensitivity Scale; TAS-26: Toronto Alexithymia Scale

## Declarations

### Ethics approval and consent to participate

Ankara University Ethics Committee Committee unanimously decided on January 27, 2020 that this study is ethically appropriate.

Informed consent was obtained from all individual participants included in the study.

### Consent for publication

Not applicable

### Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to confidentiality, but are available on reasonable request from the corresponding author. The set of questionnaires used in this study only included published questionnaires (BSI, CTQ, EYES, TAS-26 see methods section

for details).

## Competing interests

The authors declare that they have no competing interests

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## Authors' contributions

All Authors conducted literature searches and provided summaries of previous research studies. PKD and SO designed the study, created the study questions, and administered surveys of the study. ADB took part in the statistical analysis. All authors took part in all writing parts of the study and reviewed the manuscript.

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## Figures

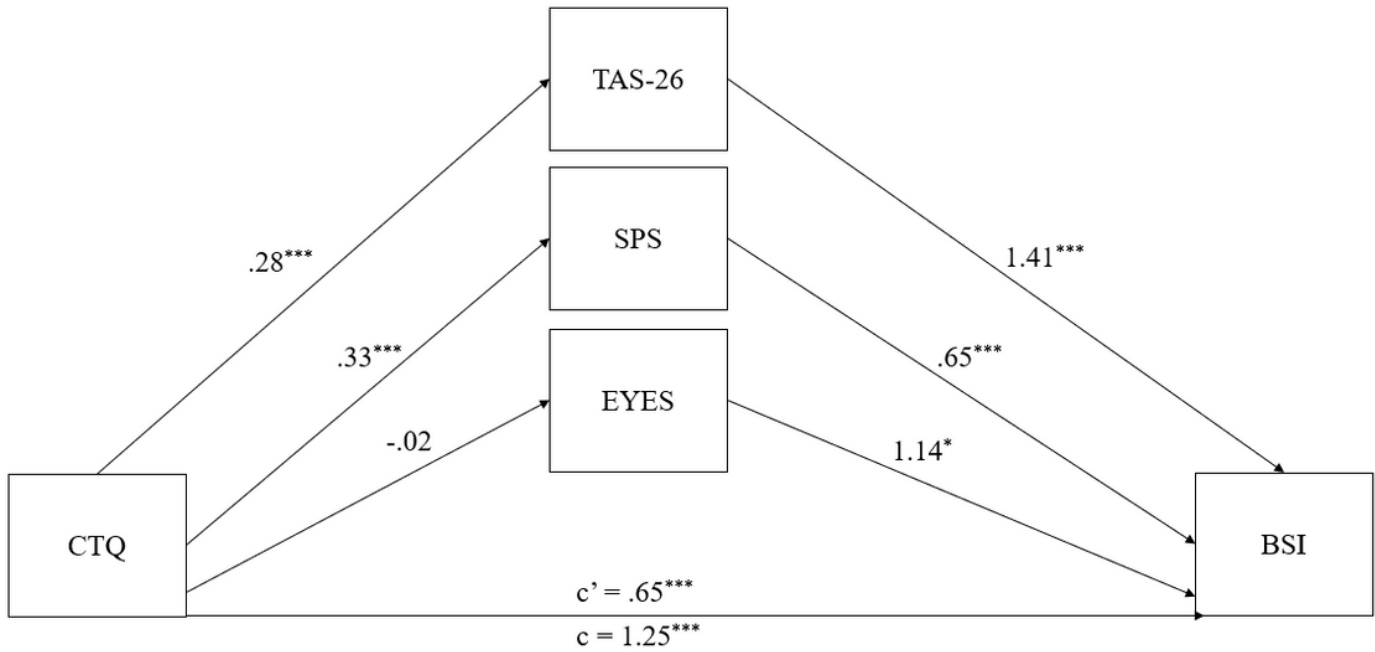


Figure 1

Mediating role of Sensory processing sensitivity, Alexithymia, Eyes in the relationship between childhood trauma and psychological symptoms Note 1. BSI= Brief Symptom Inventory, SPS= Sensory Processing Sensitivity Scale, TAS-26= Toronto Alexithymia Scale, CTQ= Childhood Trauma Questionnaire, EYES= Reading Mind in The Eyes Test Note 2. \*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ . Note 3. The results were obtained after controlling for the effect of the gender variable.

## Supplementary Files

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