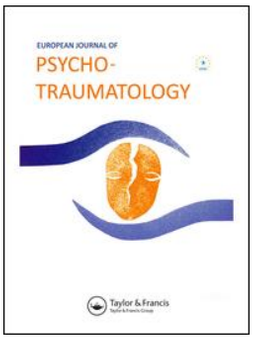

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Sensory modulation difficulties and complex PTSD among child abuse survivors

Nitzan Avigail Kidra[a], Lee Gafter[b,c], Tami Bar-Shalita[a] and Yael Lahav [a]

[a]Department of Occupational Therapy, The Stanley Steyer School of Health Professions, Faculty of Medical and Health Sciences, Tel Aviv University, Tel-Aviv, Israel; [b]Faculty of Architecture and Town Planning, Technion– Israel Institute of Technology, Haifa, Israel; [c]The Interuniversity Institute for Marine Sciences, Eilat, Israel

ABSTRACT

Background: Child abuse (CA) has diverse long-term negative outcomes, including trauma-related disorders such as Posttraumatic Stress Disorder (PTSD) and Complex Posttraumatic Stress Disorder (CPTSD). Evidence suggests that CA may also result in sensory modulation dysfunction, which is related to posttraumatic distress. However, previous research has primarily explored the relationship between sensory modulation and PTSD, without examining the role of sensory modulation in both PTSD and CPTSD.

Objective: This study aimed to bridge this knowledge gap by exploring (1) sensory modulation response patterns as a function of a history of CA; (2) the relationships between sensory modulation, PTSD, and disturbances in self-organization (DSO) in CA survivors; and (3) The role of sensory modulation response patterns in the likelihood of being diagnosed with PTSD or CPTSD.

Method: An online survey was conducted among a convenience sample of Israeli female adults ($n = 426$), including 288 (67.6%) CA survivors and 138 (32.4%) participants without a history of CA. Background variables, abuse features, sensory modulation, and PTSD and CPTSD symptoms were assessed via self-report measures.

Results: CA survivors exhibited higher scores for high sensory responsiveness and a greater proportion of sensory over-responsiveness (SOR) ($Mdn = 2.00$, $\hat{p} = 31.6\%$) compared to participants without a history of CA ($Mdn = 1.74$, $\hat{p} = 12.3\%$). High sensory responsiveness was associated with both PTSD symptoms and disturbances in self-organization (DSO) symptoms ($r > 0.15$, $p < .01$). Furthermore, SOR was significantly associated with the likelihood of receiving either PTSD or CPTSD classifications ($\hat{\beta} = 0.96$, $OR = 2.6$, $p < .001$). In the presence of SOR, the gap in the predicted probabilities for the two diagnoses doubled on average across all combinations of abuse features.

Conclusion: These findings suggest that high responsiveness to sensory stimuli may be related not only to PTSD but also to the profound and enduring effects of CA, as reflected in CPTSD.

Dificultades de modulación sensorial y trastorno de estrés postraumático complejo en sobrevivientes de abuso infantil

Antecedentes: El abuso infantil (AI) tiene diversas consecuencias negativas a largo plazo, incluidas afecciones relacionadas con el trauma, como el Trastorno de Estrés Postraumático (TEPT) y el Trastorno de Estrés Postraumático Complejo (TEPT-C). La evidencia sugiere que el AI también puede provocar disfunción en la modulación sensorial, la cual está relacionada con el malestar postraumático. Sin embargo, investigaciones previas han explorado principalmente la relación entre la modulación sensorial y el TEPT, sin examinar el papel de la modulación sensorial tanto en el TEPT como en el TEPT-C.

Objetivos: Este estudio tuvo como objetivo abordar esta brecha de conocimiento mediante la exploración de: (1) los patrones de respuesta de modulación sensorial en función de un historial de abuso infantil (AI); (2) las relaciones entre la modulación sensorial, el TEPT y las alteraciones en la autoorganización (DSO, por sus siglas en inglés) en sobrevivientes de AI; y (3) el papel de los patrones de respuesta de modulación sensorial en la probabilidad estimada de ser diagnosticado con TEPT o TEPT-C.

Método: Se llevó a cabo una encuesta en línea entre una muestra por conveniencia de mujeres adultas israelíes ($n = 426$), que incluyó a 288 (67,6%) sobrevivientes de abuso infantil (AI) y 138 (32,4%) participantes sin historial de AI. Se evaluaron, mediante medidas de autoinforme, variables de antecedentes, características del abuso, modulación sensorial y síntomas de TEPT y TEPT-C.

Resultados: Las sobrevivientes de abuso infantil (AI) presentaron puntuaciones más altas en la sensibilidad sensorial elevada y una mayor proporción de sobrerrespuesta sensorial (SOR, por sus siglas en inglés) ($Mdn = 2.00$, $= 31.6\%$) en comparación con las participantes sin historial de

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Posttraumatic stress disorder; complex posttraumatic stress disorder; sensory modulation; sensory processing; child abuse; trauma

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Trastorno de estrés postraumático; trastorno de estrés postraumático complejo; modulación sensorial; procesamiento sensorial; abuso infantil; trauma

HIGHLIGHTS

- Child abuse survivors exhibited higher levels of sensory responsiveness compared to participants without a history of child abuse.
- High sensory responsiveness was linked to Posttraumatic Stress Disorder and Complex Posttraumatic Stress Disorder among child abuse survivors.
- Sensory over-responsiveness was linked to likelihood of Posttraumatic Stress Disorder and Complex Posttraumatic Stress Disorder among child abuse survivors.

CONTACT Yael Lahav yaellah1@tauex.tau.ac.il Department of Occupational Therapy, The Stanley Steyer School of Health Professions, Faculty of Medical and Health Sciences, Tel Aviv University, P.O.B. 39040, Ramat Aviv, Tel-Aviv, 69978, Israel

AI (*Mdn* = 1.74, = 12.3%). La sensibilidad sensorial elevada se asoció con síntomas tanto de TEPT como de alteraciones en la autoorganización (DSO) ($r > 0.15$, $p < .01$). Además, la SOR se asoció significativamente con la probabilidad de recibir un diagnóstico de TEPT o TEPT-C. Cuando estaba presente la SOR, la diferencia entre las probabilidades estimadas de ambos diagnósticos se duplicó, en promedio, en todas las combinaciones de características del abuso. **Conclusión:** Estos hallazgos sugieren que una alta reactividad a los estímulos sensoriales puede estar relacionada no solo con el TEPT, sino también con los efectos profundos y duraderos del abuso infantil, tal como se refleja en el TEPT-C.

Child abuse (CA) encompasses emotional, physical, and sexual abuse experienced by children under 18 years of age (Legano et al., 2009) and is a global issue that affects millions of children worldwide (Borumandnia et al., 2024; Stoltenborgh et al., 2015; World Health Organization, 2024). It is estimated that nearly 3 in 4 children aged 2–4 years regularly experience physical punishment and/or psychological violence from parents and caregivers. Furthermore, 1 in 5 women and 1 in 13 men report having been sexually abused during childhood (ages 0–17 years) (WHO, 2024).

The repercussions of CA on survivors' mental health are both prolonged and substantial. Research indicates that CA is linked to increased psychological distress and various forms of psychopathology, including depression (Gardner et al., 2019; Infurna et al., 2016; Li et al., 2016), anxiety (Abate et al., 2024; Lindert et al., 2014; Nelson et al., 2017), eating disorders (Caslini et al., 2016; McKay et al., 2022), substance abuse (Halpern et al., 2018), dissociation (King et al., 2020; Lahav & Elklit, 2016; Vonderlin et al., 2018), as well as sexual difficulties and dysfunction (Gewirtz-Meydan & Lahav, 2020a, 2020b; Wang et al., 2023). Additionally, two trauma-related disorders – Posttraumatic Stress Disorder (PTSD; World Health Organization [WHO], 2022, 6B40) and ICD-11 Complex Posttraumatic Stress Disorder (CPTSD; WHO, 2022, ICD-11, 6B41) – have been consistently documented in this population (Cloitre et al., 2019; Lahav et al., 2025; Leiva-Bianchi et al., 2023; Messman-Moore & Bhuptani, 2017).

Although the repercussions of child abuse affect both women and men, evidence suggests that women may experience more severe long-term mental health consequences than men (Prachason et al., 2024; Thompson et al., 2004). Additionally, while both PTSD and CPTSD have been documented in CA survivors, studies indicate that gender and age interact to explain variations in CPTSD rates (McGinty et al., 2021). Research has shown that women are at an increased likelihood for PTSD, reporting greater symptom severity compared to men (Olff, 2017; Olff et al., 2007; Tolin & Foa, 2008). Therefore, the present study focused on female CA survivors, examining sensory modulation as a factor that may increase the likelihood of developing PTSD and CPTSD.

Posttraumatic stress disorder (PTSD) is a condition caused by 'exposure to an extremely threatening or horrific event or series of events' (WHO, 2022, ICD-11, 6B40). Individuals with PTSD exhibit three clusters of ongoing symptoms related to the traumatic event: re-experiencing trauma, avoiding reminders of the trauma, and a heightened sense of threat. Re-experiencing trauma includes vivid intrusive memories, flashbacks, and nightmares. Avoiding reminders of the trauma may manifest as internal avoidance of thoughts and memories associated with the event, or external avoidance of people, conversations, activities, or situations reminiscent of it. A heightened sense of threat encompasses symptoms such as hypervigilance, being constantly on guard, and an enhanced startle response (WHO, 2022).

Nonetheless, exposure to prolonged interpersonal trauma, such as CA, may result in deep and widespread harm to individuals' basic functions that extend beyond PTSD (Cloitre, 2020; Herman, 1992; Lahav et al., 2025; Maercker et al., 2022; van der Kolk et al., 2005). Complex Posttraumatic Stress Disorder (CPTSD) reflects these impacts, as it requires that all diagnostic criteria for PTSD be met while also incorporating additional symptoms that indicate the profound and enduring damage caused by the trauma. Specifically, CPTSD comprises six clusters of symptoms: the three PTSD clusters and three symptom clusters that represent 'disturbances in self-organization' (DSO): (1) affect dysregulation (i.e. difficulties in regulating affect, manifested in heightened or diminished emotional reactivity); (2) persistent negative self-concept (i.e. beliefs about oneself as diminished or worthless); and (3) persistent difficulties in forming and maintaining relationships (i.e. limited interest in relationships or difficulty sustaining established ones). Although both PTSD and CPTSD have been documented in CA survivors, exposure to repeated traumas during early development is associated with a greater likelihood of developing CPTSD rather than PTSD (Cloitre et al., 2019). Additionally, CPTSD, compared to PTSD, is more severe, persistent (WHO, 2022), and linked to poorer functional impairment and other comorbid conditions, such as depression and dissociation (Hyland et al., 2018; Karatzias et al., 2017; van Dijke et al., 2012).

The detrimental effects of childhood abuse may be linked to sensory modulation patterns of response. Sensory modulation is the ability to regulate responses to sensations in a graded and adaptive manner, allowing for appropriate functioning (Dunn et al., 2016; Koziol et al., 2011; Miller et al., 2007). Difficulties in sensory modulation, known as sensory modulation dysfunction (SMD), is a neurodevelopmental condition that can affect one or multiple sensory systems (Miller et al., 2007). SMD typically manifests in two primary patterns: sensory over-responsiveness (SOR) and sensory under-responsiveness (SUR) (Miller et al., 2007).

SOR is characterized by heightened and prolonged responses to daily non-painful sensations, often experienced as aversive or even painful (Bar-Shalita et al., 2019; Schwarzlose et al., 2023). This heightened sensitivity can lead to maladaptive reactions, such as anxiety, impulsivity, aggression, avoidance of stimuli, and difficulty relaxing (Bar-Shalita & Cermak, 2016; Carpenter et al., 2019; Granovsky et al., 2019; McMahon et al., 2019; Schwarzlose et al., 2023), significantly interfering with daily functioning and quality of life (Bailliard et al., 2022; Bar-Shalita et al., 2015). In contrast, SUR refers to hyposensitivity to stimuli, which may result in missing or ignoring sensory inputs. This diminished sensitivity can hinder effective daily functioning across various aspects of life (Miller et al., 2007) and has been linked to anxiety in children (Bart et al., 2017).

Based on the trauma literature, it appears that CA may shape sensory modulation, which in turn increases survivors' vulnerability to both PTSD and CPTSD. Exposure to repeated, extremely threatening or horrific events can overwhelm children, who, due to their developmental stage, cannot independently modulate arousal (van der Kolk, 2005) and may misperceive or misinterpret sensory cues (Ogden et al., 2006). SMD, in turn, may heighten the vulnerability of CA survivors to posttraumatic distress, as manifested in PTSD and CPTSD. SOR may intensify sensations associated with actual abuse or the threat of it, hindering the ability to reprocess the trauma, as seen in PTSD (Charny et al., 2023), and deepening disturbances in self-organization, as observed in CPTSD. At the same time, SUR may increase reliance on detachment and dissociation, which are counterproductive for trauma reprocessing (Charny et al., 2023) and have been identified as factors that increase the likelihood of both disorders (e.g. Levin et al., 2023; Murray et al., 2002; Werner & Griffin, 2012). Thus, both high and low sensory responsiveness may increase the likelihood of PTSD and CPTSD among CA survivors.

Although research on CA and sensory modulation has been limited, evidence supports a connection between the two (Fraser et al., 2017; Harricharan et al., 2021). A previous study found that children with a history of maltreatment exhibited higher rates of SMD compared to controls (Howard et al., 2020). Similarly, a study involving participants with unipolar and bipolar disorders revealed associations between childhood maltreatment and sensory modulation dysfunction (Serafini et al., 2016).

Research has documented the relationships between SMD and distress following trauma. Previous studies have shown that individuals with sensory modulation difficulties often experience PTSD symptoms after various types of trauma (Engel-Yeger et al., 2013; Kimball, 2023; Yochman & Pat-Horenczyk, 2020), including CA (Joseph et al., 2021; Joseph et al., 2022). Additionally, recent studies among civilians exposed to rocket attacks during wartime suggest that heightened sensory responsiveness may increase vulnerability to trauma-related symptoms (Charny et al., 2023; Huberman et al., 2025). A cross-sectional study indicated that the likelihood of elevated symptomatology during or shortly after trauma exposure doubled with each increase in the high sensory-responsiveness scores (Charny et al., 2023). Furthermore, a longitudinal study demonstrated that high sensory responsiveness predicted PTSD symptoms, including hyperarousal, intrusion, and negative alterations in mood and cognition (Huberman et al., 2025).

Nonetheless, the relationship between SMD and CPTSD following CA remains an open question. To the best of our knowledge, no study has yet explored the relationships between sensory responsiveness or SMD and the symptoms or classifications of both PTSD and CPTSD in CA survivors or other populations of trauma survivors. This exploration is crucial given the high prevalence of both PTSD and CPTSD among CA survivors, particularly since CPTSD is often more severe and persistent than PTSD.

The present study addresses this gap by investigating sensory modulation, PTSD, and CPTSD among women with a history of CA. The study has three main objectives: (1) to explore sensory modulation response patterns based on a history of CA; (2) to assess the relationships between sensory modulation, PTSD, and DSO in CA survivors; and (3) To evaluate the association between sensory modulation response patterns and the likelihood of being diagnosed with PTSD or CPTSD.

1. Methods

1.1. Participants and procedure

An online survey was conducted among a convenience sample of Israeli female adults. A secure web-based data collection system was published on social media and was accessible through Qualtrics. The survey was advertised as a study exploring the implications

of adverse childhood events on women's well-being and took an average of 30 minutes to complete. It was open from September 2022 to February 2023. The survey was anonymous, and no data were collected that linked participants to recruitment sources. The Tel Aviv University institutional review board (IRB) approved all procedures and instruments. Clicking on the link to the survey directed potential respondents to a page that provided information about the study's purpose, the nature of the questions, and a consent form. The first page also included the researcher's contact information.

A total of 659 women responded to the survey, of whom 426 completed the sensory responsiveness questionnaire, forming the current sample (see Table 1). As shown in Table 1, most participants were secular ($n = 320$, 75.1%) and held a bachelor's degree or higher ($n = 275$, 64.2%). The majority of the sample reported an income below the average ($n = 309$, 72.5%), and more than half indicated that they were in a relationship ($n = 246$, 57.7%).

Of the total sample, 288 (67.6%) participants reported a history of CA based on the Childhood Trauma Questionnaire–Short Form (CTQ-SF; Bernstein et al., 2003). Classification of CA was based on cutoff scores suggested by Tietjen et al. (2010): physical abuse ≥ 8, sexual abuse ≥ 6, and emotional abuse ≥ 9. Participants exceeding any of these cutoffs were classified as having a history of CA.

Among this subgroup of participants ($N = 288$), 130 (45.1%) were classified as having a history of child physical abuse, 212 (73.6%) were classified as having a history of child sexual abuse, and 259 (89.9%) were classified as having a history of child emotional abuse. Thus, the majority of the sample ($n = 216$, 75%) was classified as having a history of at least two types of abuse, indicating polyvictimization. The average age at which the abuse began was 8.52 years, and the vast majority of the sample reported exposure to recurrent abuse ($n = 239$, 83%).

Table 1. Description of demographic characteristics of the sample ($N = 426$).

	M (SD) or *n* (%)
History of CA	
Yes	288 (67.6)
No	138 (32.4)
Age	35.12 (10.74)
Education	
High school diploma or less	81 (19)
Vocational or other training	70 (16.4)
Undergraduate degree	158 (37.1)
Graduate degree	117 (27.4)
Religiosity	
Secular	320 (75.1)
Religious/conservative	93 (21.8)
Other	13 (3.1)
Income	
Below average	309 (72.5)
Average	52 (12.2)
Above average	65 (15.3)
Relationship status	
In a relationship	246 (57.7)
Not in a relationship	180 (42.3)

1.2. Measures

1.2.1. Background variables

Participants completed a brief demographic questionnaire that assessed their age, education level, income, and relationship status.

1.2.2. Features of abuse

Participants with a history of CA were asked to specify several features of the abuse: (1) their age when the abuse began and (2) whether the abuse was a one-time event or recurrent. Additionally, exposure to one type of abuse versus polyvictimization was determined based on participants' responses to the CTQ-SF (Bernstein et al., 2003).

1.2.3. Classification and symptoms of PTSD and CPTSD

The International Trauma Questionnaire (ITO; Cloitre et al., 2018) was used to measure symptoms of ICD-11 PTSD and CPTSD. Respondents who reported a history of CA were instructed to answer all questions in relation to their experiences. The questionnaire includes six items that assess PTSD symptoms across the clusters of 'Re-experiencing in the Here and Now,' 'Avoidance,' and 'Sense of Threat.' Participants indicate how much they have been bothered by each symptom in the past month. Additionally, three questions evaluate functional impairment in social, occupational, and other important life areas related to these symptoms.

The questionnaire also includes six items measuring DSO symptoms across the clusters of 'Affective Dysregulation,' 'Negative Self-Concept,' and 'Disturbed Relationships.' Respondents answer these questions based on their typical feelings, thoughts about themselves, and interactions with others. Furthermore, three items measure functional impairment associated with DSO symptoms.

All items are rated on a five-point scale that ranges from 0 (Not at all) to 4 (Extremely). A symptom is considered present if the score is ≥ 2 (Moderately) on the scale. In this study, the internal consistency was high: 0.90 for PTSD symptoms, 0.88 for DSO symptoms, and 0.91 for the 12 items of the scale.

For a diagnosis of PTSD, at least one symptom must be present from each PTSD cluster, along with at least one indicator of functional impairment associated with these symptoms. To meet the diagnostic criteria for CPTSD, at least one symptom must be present from the six symptom clusters, along with endorsement of functional impairment related to both PTSD and DSO symptoms. According to the

ICD-11 diagnostic guidelines, a person may be diagnosed with either PTSD or CPTSD, but not both.

1.2.4. Sensory modulation

Sensory modulation was measured using the Sensory Responsiveness Questionnaire-Intensity scale (SRQ-IS; Bar-Shalita et al., 2009). This scale consists of 58 scenarios typical in daily life, each phrased to convey either hedonic or aversive valence (e.g. 'I enjoy being in a place that is brightly lit'; 'Washing my face bothers me'; 'Going down an escalator bothers me'; 'Smelling perfume bothers me'). Each item refers to a single sensory stimulus in one of the following modalities: auditory, visual, gustatory, olfactory, vestibular, and somatosensory (excluding pain). Participants were asked to rate the intensity of their hedonic or aversive response to each scenario on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much). This yielded two scale scores: the SRQ-Aversive and SRQ-Hedonic, which indicate high and low sensory responsiveness, respectively. Additionally, SOR and SUR can be identified using the mean (SD) cut-offs of 1.87 (0.26) and 2.10 (0.33), respectively. In this study, we employed a conservative approach by using 2 SDs as the cut-offs. The SRQ-IS demonstrates high internal consistency and test-retest reliability (Bar-Shalita et al., 2009). The internal consistency reliabilities in this study for high sensory responsiveness (SRQ-Aversive) and low sensory responsiveness (SRQ-Hedonic) scores were good ($\alpha = 0.86$ and 0.77, respectively).

1.3. Data analysis

The analyses were performed using R software. Among the total sample size of 426 participants, there were no missing data relevant to each analysis, and no imputation procedures were needed to fit the data in our study. Numerical outlier observations were tested using Mahalanobis' distance measure, applying the conservative threshold of $p < .0001$ to set a critical χ^2 value (De Maesschalck et al., 2000). None of the observations were detected as outliers.

To explore differences in sensory modulation between CA survivors and participants with no history of CA, we performed group-wise comparisons using the Mann–Whitney test. Additionally, we used Pearson's point biserial correlation coefficient to measure both the directionality of the association and its effect size. We then assessed the association between SMD and history of CA by conducting a contingency table analysis with Pearson's χ^2 test.

Next, to explore the relationship between sensory modulation and PTSD symptoms, as well as CPTSD symptoms in the group of CA survivors, we conducted association analyses. Measures of association and dependence were calculated using Pearson's correlation coefficient where applicable, Kendall's τ_B and τ_C in cases where values were limited to fewer than four (i.e. in the subscales of the PTSD and CPTSD measures), Pearson's point biserial correlation for continuous-nominal relationships, and the χ^2's ϕ measure of association for nominal-nominal relationships (Hollander & Wolfe, 1999). All continuous data were tested for univariate and multivariate normality using the Shapiro–Wilk test and the Mardia test (Villasenor Alva & Estrada, 2009).

Given the hierarchical structure of the diagnostic categories – both theoretically and as reflected in the ITQ measurement tool (No diagnosis < PTSD < CPTSD) – we employed an ordinal logistic regression model to estimate the probability of PTSD/CPTSD relative to no diagnosis, as a function of sensory modulation classification in CA survivors. We evaluated the proportional odds assumption of the model using the Likelihood Ratio (LR) test for the parallel lines assumption (Peterson & Harrell Jr, 1990). Since the null hypothesis was not rejected for all explanatory variables, no individual slopes were added to the model. Model diagnostics included calculating Cragg and Uhler's (Nagelkerke) pseudo-R^2 value and the Lipsitz goodness-of-fit test for ordinal response models (Lipsitz et al., 1996). We estimated the ordinal models twice: with and without the features of abuse and age variables. The role of the additional variables in the models was evaluated using the cumulative link models' LR test, as suggested by Christensen (2018). Due to the factorial structure of the data, we also tested for the significance of second-order interaction effects using an AIC-based search method for feature selection (Wiegand, 2010). To estimate the effect of sensory modulation diagnosis on the probability of each classification, we derived the probabilities from the best-fitting model, utilizing the factorial structure of the binary variables' space and the mean values of the continuous covariates.

2. Results

2.1. Sensory modulation in CA survivors versus participants without a history of CA

We began our analysis with a group-wise comparison of high and low sensory responsiveness, measured using the SRQ-Aversive and SRQ-Hedonic scale scores, respectively (continuous values), in CA survivors and participants without a history of CA. A Mann–Whitney U test revealed a statistically significant difference with a medium effect size in high sensory responsiveness scores between CA survivors ($Mdn = 2.00$), $U = 13073.50$, $p < .001$, $r_{pb} = 0.34$ and participants with no history of CA ($Mdn = 1.74$). Specifically, CA survivors exhibited higher scores for high sensory responsiveness than participants without a history of CA. In contrast, the results for low sensory

responsiveness were not statistically significant, $U = 18,120.50$, $p = .141$, $r_{pb} = 0.09$, indicating a small effect size; there was no difference in low sensory responsiveness scores between the two groups.

Next, we compared the values of SUR and SOR (i.e. SMD patterns). Of the total 426 female respondents, 108 (25.4%) met the threshold for SOR, while only 2 (0.5%) met the threshold for SUR. Due to the negligible frequency of respondents with SUR, we could not make meaningful comparisons between the groups and excluded this variable from further analyses. An independence test for the association between SOR and CA revealed a significant association between the two, with a small effect size ($\chi_1^2 = 17.30, p < .001 \varphi = 0.20$). The proportion of SOR among CA survivors was considerably higher (31.6%) compared to participants without a history of CA (12.3%).

2.2. PTSD and CPTSD classification in CA survivors

Based on the ITQ, of the 288 CA survivors, 8.0% ($n = 23$) met the diagnostic requirements for PTSD, while an additional 29.9% ($n = 86$) met the criteria for CPTSD. The remaining 62.1% ($n = 179$) did not meet the criteria for either diagnosis. The frequencies of symptom cluster endorsement were as follows: the most commonly endorsed symptom cluster was affective dysregulation (75.3%), followed by disturbed relationships (66%), sense of current threat (63.5%), negative self-concept (59.4%), avoidance (58.7%), and re-experiencing (43.4%).

2.3. Sensory modulation and symptoms of PTSD and CPTSD in CA survivors

As shown in Table 2, correlation analysis revealed a positive and statistically significant association between high sensory responsiveness and all PTSD and DSO symptom clusters, as well as total scores. Specifically, high sensory responsiveness was associated with re-experiencing symptoms, $r = 0.22$, $p < .01$; avoidance, $r = 0.23$, $p < .001$; sense of threat, $r = 0.26$, $p < .01$; affective dysregulation, $r = 0.15$, $p < .01$; negative self-concept, $r = 0.21$, $p < .001$; disturbed relationships, $r = 0$ .16, $p < .01$; PTSD total score, $r = 0.23$, $p < .001$; and CPTSD total score, $r = 0.16$, $p < .001$. No significant associations were found between low sensory responsiveness and either PTSD and DSO symptom clusters or total scores.

2.4. The effect of SOR on PTSD and CPTSD classification in CA survivors

We began our analysis by estimating the effect of SOR on the odds of PTSD and CPTSD classifications compared to the reference category of no classification, using a model that excluded abuse variables and age. The model satisfied the proportional odds assumption ($\chi_1^2 = 1.60$, $p = .211$), and no adjustments to the ordinal model were necessary. Results from the LR test indicated that the model had significantly greater explanatory power than the null model ($\chi_1^2 = 16.85$, $p < .001$).

Next, we estimated a model that included all features of abuse and age as explanatory variables. The second model also met the proportional odds assumptions ($\chi_5^2 = 3.21, p = .673$ and $\chi_1^2 < 1.39$, $p > .242$ for the omnibus test and individual tests for each variable, respectively). The LR test revealed that including the additional variables significantly enhanced the model's explanatory power ($\chi_4^2 = 16.29, p = .002$). Lipsitz's goodness-of-fit test confirmed that the final model met the specifications of the ordinal logistic model ($\chi_9^2 = 9.3$, $p = .411$). The model's explanatory power over the null model was 0.13. No significant interactions or second-order effects were identified in our data. Results from both the constrained and unconstrained ordinal logistic models are presented in Table 3.

SOR had a significant effect on the probability of receiving either PTSD or CPTSD classifications ($\hat{\beta} = 0.96, p < .001$), increasing the odds of CPTSD by 2.6. Exposure to recurrent abuse had a significant effect on the classification as well ($\hat{\beta} = 1.17, p = .005$), increasing the odds of such diagnoses by 3.2. The polyvictimization variable was marginally associated with

Table 2. Correlations between sensory modulation and symptoms of PTSD and CPTSD in CA survivors ($N = 286$).

	1	2	3	4	5	6	7	8	9
1. Low sensory responsiveness	–								
2. High sensory responsiveness	.27***	–							
3. Re-experiencing	−.08	.22**	–						
4. Avoidance	−.06	.23***	.58***	–					
5. Sense of threat	−.07	.26**	.54***	.66***	–				
6. Affective dysregulation	−.04	.15**	.40***	.53***	.54***	–			
7. Negative self concept	−.02	.21***	.34***	.48***	.50***	.6***	–		
8. Disturbed relationships	−.06	.16**	.43***	.57***	.53***	.69***	.60***	–	
9. PTSD total score	−.06	.23***	.80***	.85***	.82***	.56***	.48***	.57***	–
10. CPTSD total score	−.04	.16***	.41***	.56***	.58***	.84***	.78***	.80***	.67***

***$p < .001$,**$p < .01$.

Note. Kendall's τ_B and Kendall's τ_C serve as a measure of association where Pearson correlation is inapplicable.

Table 3. Results of the ordinal logistic regression (Partial proportional odds) for the constrained and unconstrained models.

	Constrained model					Unconstrained model					
	$\hat{\beta}$	OR	None|PTSD OR	PTSD|CPTSD	OR	$\hat{\beta}$	OR	None|PTSD	OR	PTSD|CPTSD	OR
Intercept			0.86*** (0.15)	1.24*** (0.16)				1.65* (0.75)		2.05** (0.76)	
SOR	1.05*** (0.26)	2.86				0.96*** (0.26)	2.60				
Abuse recurrency						1.17** (0.42)	3.24				
Polyvictimization						0.56 (0.31)	1.75				
Age when abuse begun						−0.02 (0.03)	0.98				
Age						−0.01 (0.01)	0.98				

***$p < .001$,**$p < .01$,*$p < .05$.
Note. Baseline category for all dichotomous variables is the null category (i.e. 'No').

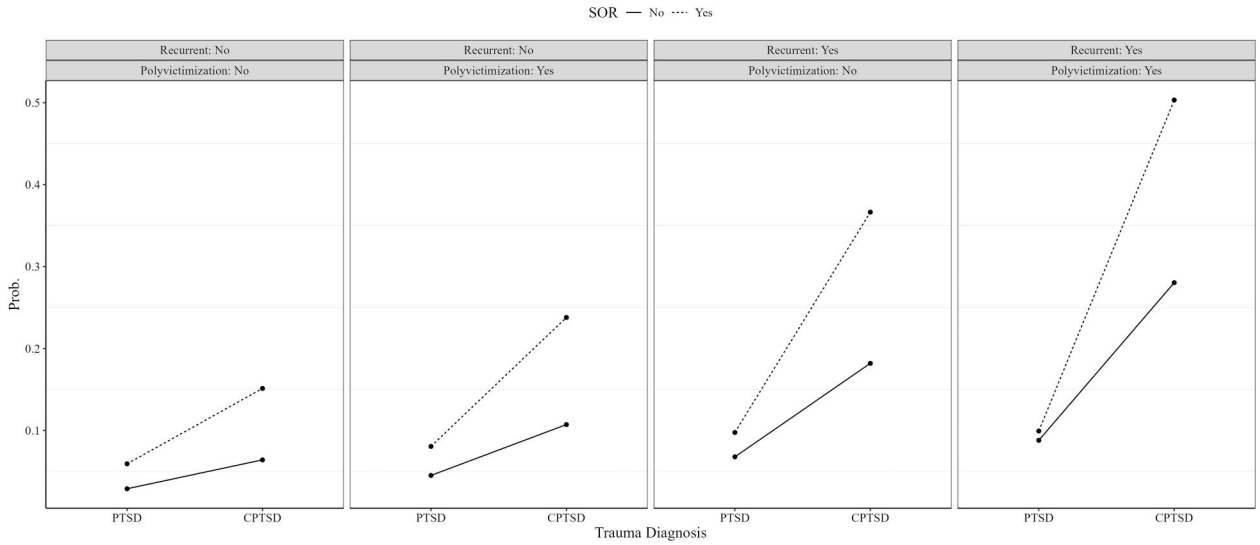

Figure 1. The effects of SOR diagnosis and features of abuse on the predicted probabilities of PTSD and CPTSD classifications.

Table 4. Predicted probabilities of no trauma classification, PTSD, and CPTSD classifications for SOR and features of abuse.

SOR	Recurrent abuse	Polyvictimization	No classification	PTSD	CPTSD
+	+	+	0.40	0.10	0.50
+	+	−	0.54	0.10	0.37
+	−	+	0.68	0.08	0.24
+	−	−	0.79	0.06	0.15
−	+	+	0.63	0.09	0.28
−	+	−	0.75	0.07	0.18
−	−	+	0.85	0.05	0.11
−	−	−	0.91	0.03	0.06

+ = 'Yes', − = 'No'.

the model ($\hat{\beta} = 0.56$, $p = .064$, $OR = 1.75$), while the age variables showed no significant effect on the odds of PTSD or CPTSD classification.

Figure 1 illustrates the effects of SOR and abuse feature variables on the predicted probabilities of PTSD and CPTSD classifications. SOR significantly increased the probability of CPTSD classification and had a more limited effect on the probability of PTSD classification across all combinations of abuse features, indicating that SOR plays a stronger role in explaining CPTSD than PTSD. Furthermore, the estimated probability of a CPTSD classification consistently remained higher than that of a PTSD classification. In the presence of SOR, the gap between the classifications doubled on average across all combinations of abuse features. The predicted probabilities for each classification across the entire sampling space of features are presented in Table 4.

3. Discussion

The current study explored, for the first time, the relationships between SMD and the symptomatology of both PTSD and CPTSD among CA survivors. Our

results indicated that CA survivors experienced a higher frequency of SOR compared to participants without a history of CA. Among CA survivors, SOR was associated with elevated symptoms of both PTSD and DSO, as well as an increased likelihood of receiving either PTSD or CPTSD classifications. Furthermore, the estimated probability of CPTSD classification was higher than that of PTSD; in the presence of SOR, the gap between the two diagnoses doubled on average across all combinations of abuse features.

Our results indicated a link between CA and SMD. Specifically, we found that CA survivors had elevated scores for high sensory responsiveness and a higher prevalence of SOR, compared to participants without a history of CA. These findings align with previous studies that document difficulties in sensory modulation among individuals who experienced child maltreatment (Fraser et al., 2017; Howard et al., 2020; Serafini et al., 2016). One potential explanation for these findings is that exposure to trauma during childhood, when individuals cannot independently regulate arousal, may impair survivors' ability to modulate sensory input (Yochman & Pat-Horenczyk, 2020). Consequently, CA survivors may exhibit high sensory responsiveness, reacting to daily non-aversive stimuli with greater intensity and for longer durations, experiencing these stimuli as aversive or even painful.

Our analyses among CA survivors indicated a relationship between high sensory responsiveness and symptoms of both PTSD and DSO. Additionally, SOR had a significant effect on the probability of receiving either a PTSD or CPTSD classification compared to no classification, *ceteris paribus* the features of abuse. Furthermore, while the estimated probability of a CPTSD classification was higher than that of PTSD in the presence of SOR, the gap between the two diagnoses doubled on average across all combinations of abuse features. These findings align with previous research documenting associations between SOR and PTSD in CA survivors (Joseph et al., 2021; Joseph et al., 2022), as well as in survivors of other types of trauma (Engel-Yeger et al., 2013; Huberman et al., 2025; Kimball, 2023; Yochman & Pat-Horenczyk, 2020). At the same time, the current findings suggest that this hypervigilance to stimuli is also related to the deep and enduring aftermath of exposure to prolonged and interpersonal trauma, as reflected in CPTSD. Three main explanations may be offered for these findings.

According to the first explanation, the symptomatology of PTSD and CPTSD may negatively affect the capacity to modulate sensory input, resulting in SOR. PTSD symptoms, such as vivid intrusive memories, flashbacks, hypervigilance, and avoidance, may adversely impact how individuals experience sensory stimuli, potentially leading to heightened sensitivity to stimuli over time. Similarly, persistent negative self-concept, difficulties in forming and maintaining relationships, and challenges in regulating affect – all of which reflect the DSO symptoms – pose a substantial emotional burden that may impede the ability to handle sensory input adaptively.

Alternatively, the present findings may indicate the implications of SOR for posttraumatic distress (Charny et al., 2023). SOR has been found to be related to psychopathology and psychological distress (Bar-Shalita & Cermak, 2016; Engel-Yeger & Rosenblum, 2021) and may increase the vulnerability of CA survivors to PTSD and CPTSD symptomatology. Specifically, the tendency to respond to stimuli with higher intensity and for longer durations may intensify the experience of threat during the abuse (Charny et al., 2023; Huberman et al., 2025), thereby deepening the effects of child abuse, as manifested in PTSD and CPTSD.

Lastly, according to the third explanation, the present findings may reflect reciprocal relations between SOR and trauma-related symptomatology. Sensory over-responsiveness may increase vulnerability to PTSD and CPTSD, which in turn further impairs the ability to modulate sensory input and intensifies responsiveness. A study examining intrinsic visual cortical activity (based on posterior alpha oscillations) and bottom-up sensory-driven causal connectivity during both a resting state (eyes open) and a passive, serial picture viewing state supports this type of relationship (Clancy et al., 2017). The results of this study revealed that participants with PTSD demonstrated intrinsic sensory hyperactivity and bottom-up inhibition deficits compared to participants with generalized anxiety disorder and healthy controls. Furthermore, these patterns were related to increased severity of sensory and executive dysfunctions (Clancy et al., 2017). The authors suggested that difficulties in sensory modulation create a vicious cycle: SOR and disinhibition lead to frontal overload, which hampers executive control, thereby perpetuating PTSD. It may be that the same process also applies to CPTSD. However, since the present results relied on a cross-sectional design, one cannot refute or support any specific directionality of the relationships between sensory over-responsiveness, PTSD, and CPTSD. Longitudinal studies exploring the relationships between these variables over time are needed.

Contrary to high sensory responsiveness and SOR, the current findings indicated non-significant differences between the groups in low sensory responsiveness and revealed an extremely low prevalence of SUR ($n = 2$), which precluded further exploration of this specific type of SMD any further. Furthermore, the results indicated that low sensory responsiveness was unrelated to PTSD or DOS symptoms. These findings are inconsistent with previous studies that

identified relationships between low responsiveness to stimuli and child abuse (Serafini et al., 2016), as well as PTSD symptoms (Engel-Yeger et al., 2013; Yochman & Pat-Horenczyk, 2020). However, the current results align with recent findings among civilians exposed to war, which revealed that low sensory responsiveness was unrelated to both early trauma-related symptoms and PTSD (Charny et al., 2023; Huberman et al., 2025).

Two possible explanations can be offered for the current findings. First, it may be that low sensory responsiveness has negative implications for the mental health of trauma survivors, but that these effects differ from those seen in PTSD or CPTSD, and therefore could not be detected in this study. Alternatively, the findings may be attributed to methodological limitations related to SUR manifestation. Specifically, individuals with SUR may have missed the call for participation in this study. As a result, the study may not only have suffered from an underrepresentation of individuals with SUR but also may have been limited in its ability to detect the implications of its non-clinical form, namely low sensory responsiveness.

The current investigation should be considered in light of its limitations. First, the cross-sectional design precludes any conclusions regarding causal relationships or the directionality of the relationships between sensory over-responsiveness, PTSD, and CPTSD. Second, our sample was gathered online and relied on convenience sampling among Israeli female participants. Additionally, the prevalence of sensory under-responsiveness was extremely low in this study, so this type of sensory modulation dysfunction was not included in the analyses. These limitations should be taken into account before generalizing the results to other populations. Third, this study was based on self-reported data, which may be subject to response biases. Future longitudinal studies should investigate sensory modulation and the symptomatology of PTSD and CPTSD over time and among a variety of populations with diverse cultural backgrounds, while combining data from self-reported questionnaires with clinical interviews.

Despite these limitations, this study provides the first empirical evidence concerning the relationships between SMD, PTSD, and CPTSD, highlighting significant clinical implications. Our findings suggest that CA survivors may exhibit SOR, which in turn could contribute to trauma-related symptomatology. This may be evident not only in PTSD symptoms but also in harm to basic functions of the self, as reflected in CPTSD. Thus, the current results imply that screening for SMD in survivors of protracted trauma, such as CA, who suffer from PTSD or CPTSD is imperative. Furthermore, applying sensory modulation strategies (Fraser et al., 2017; Ogden et al., 2006) within interventions commonly used for CPTSD – such as Skills Training in Affective and Interpersonal Regulation and Narrative Therapy (Cloitre & Schmidt, 2022; Karatzias et al., 2024) – as well as Dialectical Behavioral Therapy (Bohus et al., 2019), may be beneficial in reducing trauma-related symptomatology among abuse survivors.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available.

ORCID

Yael Lahav http://orcid.org/0000-0003-1242-9042

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