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Affective and cognitive theory of mind in posttraumatic stress, major depressive, and somatic symptom disorders: Association with childhood trauma

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Objectives. Childhood trauma constitutes a major risk factor for adult psychopathology, including posttraumatic stress disorder (PTSD), major depressive disorder (MDD), and somatic symptom disorder (SSD). One potential mechanism linking childhood trauma to adult psychopathology may be alterations in theory of mind (ToM). Given the lack of transdiagnostic studies on the association between childhood trauma and ToM, further research is needed to elucidate whether and how childhood trauma relates to ToM impairments across and within diagnostic boundaries.

Design. A cross-sectional study design was applied.

Methods. A total of 137 individuals with varying levels of childhood trauma took part in this study, encompassing individuals with PTSD (n = 33), MDD (n = 33), SSD (n = 36), and healthy volunteers (HVs; n = 35). To assess ToM performance and childhood trauma, the Movie for the Assessment of Social Cognition was administered along with the Childhood Trauma Questionnaire.

Results. Only individuals with PTSD, but not individuals with MDD or SSD, showed a worse ToM performance compared to HVs. In the whole sample, childhood trauma correlated negatively with ToM performance. Exploratory group-specific analyses revealed higher levels of childhood trauma to be associated with more excessive ToM errors in individuals with SSD, and notably with an enhanced ToM performance in individuals with MDD.

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Conclusions. Our results indicate associations between childhood trauma and ToM impairments in a large, transdiagnostic sample. Provided replication in future studies, our findings suggest ToM capacities as a promising treatment target for individuals exposed to severe childhood trauma, at least or particularly with a diagnosis of PTSD.

Practitioner points

- Our results suggest that individuals with a history of severe childhood trauma, at least or particularly with a clinical diagnosis of posttraumatic stress disorder, may benefit from therapeutic approaches targeting theory of mind capacities.
- Our findings indicate that higher levels of childhood trauma may be linked to a specific 'hypermentalizing' bias in somatic symptom disorder.
- Our findings further point towards an association between higher levels of childhood trauma and a heightened – rather than a diminished – sensitivity towards interpersonal cues in major depressive disorder.
- Provided further confirmatory evidence, our findings may support diagnosis-specific approaches in ameliorating theory of mind abilities in individuals with different mental disorders and a history of severe childhood trauma.

Childhood trauma constitutes a highly prevalent public health concern. Worldwide millions of adults live with a legacy of childhood trauma, such as abuse and neglect, with detrimental effects on mental health and well-being (Bellis et al., 2019; Nurius, Green, Logan-Greene, & Borja, 2015). As a major risk factor for a broad range of mental disorders (Copeland et al., 2018; Green et al., 2010), childhood trauma is associated with an increased likelihood of developing posttraumatic stress disorder (PTSD; Widom, 1999), major depressive disorder (MDD; Li, D'Arcy, & Meng, 2016), and somatic symptom disorder (SSD; Nelson, Baldwin, & Taylor, 2012). While childhood trauma is widely perceived as a core risk factor for PTSD (Alisic et al., 2014) and MDD (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008), emerging evidence indicates that it may also contribute to SSD (Landa, Peterson, & Fallon, 2012). However, since not every individual who experienced childhood trauma develops a mental disorder, it is crucial to gain a better understanding of the mechanisms linking childhood trauma exposure to different types of mental disorders. Gaining insight into relevant mechanisms could facilitate developing more targeted early intervention and treatment strategies, that may ultimately improve care for patients with different mental disorders and a history of childhood trauma.

According to a current transdiagnostic model (McLaughlin, Colich, Rodman, & Weissman, 2020), the association between childhood trauma exposure and multiple types of psychopathology may be explained by alterations in social cognition. Social cognition has recently been deconstructed into two overarching processes, encompassing empathy as the affective and theory of mind (ToM) as the cognitive route to understanding others (Schurz et al., 2020). Both of these overarching processes interact flexibly, with empathy relating to more sensory-affective representations and ToM relating to more abstract representations of others' mental states (Schurz et al., 2020). The term ToM defines the ability to make inferences about others' mental states, including emotions (i.e., affective ToM) as well as thoughts and intentions (i.e., cognitive ToM; Schurz, Radua, Aichhorn, Richlan, & Perner, 2014). Besides differentiating between affective and cognitive mental state inferencing, ToM can also be regarded on a dimensional continuum spanning mental state inferences that are excessive, adequate,

insufficient, or completely lacking. Furthermore, ToM may be divided into ToM decoding (i.e., identifying others' mental states from observable social information such as facial expressions) and ToM reasoning (i.e., interpreting others' mental states and predicting their behavior by integrating contextual social information about them; Washburn, Wilson, Roes, Rnic, & Harkness, 2016; Wolkenstein, Schönenberg, Schirm, & Hautzinger, 2011). Finally, ToM may be split into first-order ToM (i.e., what I think about another person's mental state) and second-order ToM (i.e., what I think another person thinks about a third party's mental state).

Emerging evidence suggests that impairments in ToM could contribute to adult psychopathology following childhood trauma. Intact ToM is deemed critical for adapting to complex social environments (Byom & Mutlu, 2013). Deficits in ToM have been found in several mental disorders (Cotter et al., 2018) which are characterized by high prevalence rates of childhood trauma, including PTSD (Plana, Lavoie, Battaglia, & Achim, 2014; Stevens & Jovanovic, 2019), MDD (Bora & Berk, 2016; van Neerven, Bos, & van Haren, 2021), bipolar disorder (Bora, Bartholomeusz, & Pantelis, 2016), schizophrenia (Quidé et al., 2017; Vaskinn, Melle, Aas, & Berg, 2020), and SSD (Subic-Wrana, Beutel, Knebel, & Lane, 2010; Zunhammer, Halski, Eichhammer, & Busch, 2015). Additionally, ToM impairments have been shown to be associated with childhood trauma (Germine, Dunn, McLaughlin, & Smoller, 2015; Quidé et al., 2018; Rokita, Dauvermann, & Donohoe, 2018), and to mediate the effect of childhood trauma on adult psychopathology, including, but not restricted to, symptoms of PTSD (Huang, Fonagy, Feigenbaum, Montague, & Nolte, 2020) and MDD (Li, Carracher, & Bird, 2020).

Taken together, a comprehensive body of literature supports the notion that deficits in ToM may represent a core phenotype of mental disorders with high prevalence rates of childhood trauma. Deficits in ToM may thus serve as a potential target for transdiagnostic interventions that aim at preventing or treating mental disorders associated with childhood trauma. However, up to now, only a few studies have investigated ToM performance across multiple mental disorders compared to healthy volunteers (HVs; e.g., Buhlmann, Wacker, & Dziobek, 2015). Moreover, given the lack of transdiagnostic studies examining the association between childhood trauma and ToM, the question remains regarding whether and how childhood trauma is related to ToM impairments across and within diagnostic boundaries.

To address these questions, we investigated ToM performance in a large sample of individuals with varying levels of childhood trauma, both with and without different mental disorders. Considering issues of assessing ToM in an ecologically valid manner (for discussion, see Dodell-Feder & Germine, 2018; Oakley, Brewer, Bird, & Catmur, 2016), we used the *Movie for the Assessment of Social Cognition* (MASC; Dziobek et al., 2006). The MASC involves watching a short movie and answering questions concerning the characters' mental states. It measures subtle ToM difficulties independent of socio-demographic characteristics (Boada et al., 2020), is highly sensitive in discriminating between individuals with different mental disorders as well as between the latter and HVs (Martinez et al., 2017; Vaskinn et al., 2015), and is predictive of psychosocial functioning in clinical samples (Wastler & Lenzenweger, 2020). In line with previous studies using different ToM tasks, studies administering the MASC indicate ToM impairments in adults with MDD (Wolkenstein et al., 2011; Zwick & Wolkenstein, 2017; but see Wilbertz, Brakemeier, Zobel, Härter, & Schramm, 2010, for divergent results), SSD (Schönenberg et al., 2014), and comorbid PTSD (Preißler, Dziobek, Ritter, Heekeren, & Roepke, 2010) compared to HVs. Furthermore, higher levels of self-reported childhood trauma have been associated with more errors in the MASC in clinical and healthy samples (Duque-Alarcón,

Alcalá-Lozano, González-Olvera, Garza-Villarreal, & Pellicer, 2019; Kvarstein et al., 2020; Vaskinn et al., 2020). Nevertheless, since previous studies have largely focused on one clinical condition, differences in the association between childhood trauma and ToM performance among multiple mental disorders have gone unexplored.

The objectives of the present study were to (1) compare ToM performance among individuals with PTSD, MDD, SSD, and HVs using the MASC, (2) investigate the association between childhood trauma and ToM performance transdiagnostically, and (3) explore the within-group associations between childhood trauma and ToM performance. We expected individuals with mental disorders to perform worse on the MASC than HVs. Additionally, we expected that higher levels of self-reported childhood trauma would be associated with more severe ToM impairments as assessed using the MASC in the whole sample (i.e., transdiagnostically). Finally, we explored group-specific differences in the association between childhood trauma and ToM performance.

Methods

Participants

One hundred and forty individuals with varying levels of childhood trauma took part in the current study, including participants with PTSD (n = 33), MDD (n = 35), SSD (n = 36), and HVs (n = 36). The current study was part of a larger project within the German Research Foundation's Research Training Group 2350, which investigates the impact of adverse childhood experiences on psychosocial and somatic conditions across the lifespan (Cackowski & Schmahl, 2019). Three individuals (two MDD and one HV) were excluded due to being outliers (i.e., MASC scores exceeding 3 *SD* of the subgroup's mean; see Oakley et al., 2016), leaving a final sample of 137 individuals. According to an a priori power analysis, our sample size was sufficient to detect small group by condition interactions (η^2 = .02) and small correlations (r = .24) in the whole sample with a statistical power of $1 - \beta \geq .80$ (Faul, Erdfelder, Lang, & Buchner, 2007). Groups were matched for age, sex, and years of education (see Table 1 for sample characteristics and group comparisons).

Participants with mental disorders were recruited through a clinical referral from inpatient and outpatient units (n = 71) and via advertisements (n = 33), and HVs were recruited via advertisements. The recruitment procedure aimed to cover a broad range of childhood trauma severity within each subgroup. The inclusion criterion for participants with mental disorders was a current diagnosis of PTSD, MDD, or SSD, as assessed using the Structured Clinical Interview for DSM-5 (SCID-5; Beesdo-Baum, Zaudig, & Wittchen, 2019). Due to high comorbidity rates among the three included disorders, participants could be diagnosed with up to three of these disorders; diagnostic group allocation was based on the current diagnosis which had also been assigned as the participant's first-lifetime disorder. The inclusion criterion for HVs was no current or past manifest mental disorder, as determined using the SCID-5 (Beesdo-Baum et al., 2019). Exclusion criteria for all participants, both with and without mental disorders, comprised age under 18 years or over 60 years; neurological disorders; current substance abuse (urine toxicology screening); severe medical illness; pregnancy; and left-handedness. Additional exclusion criteria for participants with mental disorders were lifetime diagnoses of schizophrenia, schizoaffective, or bipolar disorder, and self-reported substance dependence in the last 2 years. Participants with mental disorders were permitted to take their regularly

Table 1. Sample characteristics

Characteristic[a]	PTSD (n = 33)	MDD (n = 33)	SSD (n = 36)	HVs (n = 35)	F or χ^2 value	p value
Demographic information						
Age, years	34.33 (12.48)	30.45 (11.12)	30.42 (11.82)	29.34 (9.69)	1.26	.291
Female, no. (%)	28 (84.8)	23 (69.7)	28 (77.8)	28 (80.0)	2.32[b]	.509
Educational level, years	11.97 (1.61)	12.48 (1.25)	11.89 (1.62)	12.63 (1.06)	2.38	.073
Childhood trauma						
CTQ total score	69.82 (22.84)	46.97 (12.47)	41.28 (12.35)	45.09 (14.86)	21.60	<.001
CTQ Emotional Abuse	17.97 (6.20)	12.94 (5.56)	10.67 (4.92)	11.49 (5.32)	11.96	<.001
CTQ Physical Abuse	11.94 (6.10)	7.27 (2.98)	6.56 (2.89)	8.40 (4.41)	10.53	<.001
CTQ Sexual Abuse	10.85 (6.50)	5.91 (2.43)	5.61 (2.02)	5.89 (2.05)	15.57	<.001
CTQ Emotional Neglect	18.06 (5.53)	13.67 (5.02)	11.61 (4.99)	11.86 (4.57)	11.89	<.001
CTQ Physical Neglect	11.00 (4.58)	7.18 (2.38)	6.83 (2.32)	7.46 (2.88)	12.64	<.001
Clinical symptom severity						
BSI GSI	1.26 (0.67)	1.42 (0.54)	0.78 (0.42)	0.30 (0.34)	34.41	<.001
PCL-5 total score	41.36 (13.16)	28.12 (19.43)	16.39 (15.14)	8.17 (10.67)	31.93	<.001
BDI-II total score[c]	25.34 (11.75)	32.72 (9.90)	15.94 (9.40)	5.03 (4.36)	57.75	<.001
SSD-12 total score[c]	19.50 (9.96)	17.03 (10.48)	29.81 (7.27)	8.14 (8.02)	34.99	<.001
Current medication						
Psychotropic medication load	0.76 (1.00)	1.18 (1.24)	0.50 (1.00)	0 (0)	9.54	<.001
Antidepressants, no. (%)	13 (39.4)	19 (57.6)	8 (22.2)	0 (0)		
Antipsychotics, no. (%)	3 (9.1)	2 (6.1)	1 (2.8)	0 (0)		
Anticonvulsants, no. (%)	1 (3.0)	0 (0)	1 (2.8)	0 (0)		
Current mental disorder, no. (%)						
PTSD	33 (100.0)	2 (6.1)	1 (2.8)	0 (0)		
MDD	8 (24.2)	33 (100.0)	7 (19.4)	0 (0)		
SSD	2 (6.1)	1 (3.0)	36 (100.0)	0 (0)		
Other anxiety disorders	5 (15.2)	7 (21.2)	4 (11.1)	0 (0)		
Other affective disorders	3 (9.1)	3 (9.1)	2 (5.6)	0 (0)		
Eating disorders	3 (9.1)	2 (6.1)	1 (2.8)	0 (0)		

Note. BDI-II, Beck Depression Inventory revised; BSI GSI, Brief Symptom Inventory Global Severity Index; CTQ, Childhood Trauma Questionnaire; HVs, healthy volunteers; MDD, major depressive disorder; PCL-5, PTSD Checklist for DSM-5; PTSD, posttraumatic stress disorder; SSD, somatic symptom disorder; SSD-12, Somatic Symptom Disorder B Criteria Scale.

[a]Data are presented as mean (*SD*) unless otherwise indicated; [b]χ^2 value; [c]Data are missing for one individual with PTSD.

prescribed antidepressants, antipsychotics (sleep-inducing effect only), and/or anticonvulsants (i.e., pregabalin, pain-relieving effect only).

Measures

Mental disorders

Qualified diagnosticians (i.e., with at least a master's degree in clinical psychology) assessed mental disorders using the German version of the SCID-5 (Beesdo-Baum et al., 2019). Diagnosticians received standardized diagnostic training before the beginning of the study. Interrater reliability was established by randomly selecting 12 video-taped diagnostic interviews which were rated by the head of the diagnostic unit and 5 independent raters, yielding an interrater reliability of $\kappa = 1.00$, which can be characterized as excellent according to Cicchetti (1994).

Childhood trauma

We assessed childhood trauma using the German version of the Childhood Trauma Questionnaire (CTQ; Klinitzke, Romppel, Häuser, Brähler, & Glaesmer, 2012), a 28-item self-report questionnaire measuring emotional, physical, and sexual abuse as well as emotional and physical neglect. The five childhood trauma subscales consist of five items each. Items are scored on a five-point Likert scale ranging from 1 (*not at all*) to 5 (*very often*). Total scores range from 25 to 125, and subscale scores range from 5 to 25, with higher scores reflecting more severe abuse or neglect. Cutoff scores of 8 (Physical Abuse, Sexual Abuse, and Physical Neglect), 10 (Emotional Abuse), and 15 (Emotional Neglect) have been proposed to indicate the presence of childhood trauma (Walker et al., 1999). In the current sample, the internal consistency of four of the five subscales ranged from good (i.e., Cronbach's $\alpha = .85$ for Physical Abuse) to excellent (i.e., Cronbach's $\alpha = .95$ for Sexual Abuse), with the exception of Cronbach's $\alpha = .66$ for Physical Neglect.

Current symptom severity

We quantified current symptom severity using generic and diagnosis-specific self-report questionnaires. General psychopathology was assessed with the German version of the 53-item Brief Symptom Inventory (BSI; Franke, 2000). The BSI Global Severity Index (BSI GSI), defined as the mean of all items, ranges from 0 to 4, with higher scores reflecting more severe general psychopathology. A BSI GSI of $\geq$0.62 has been proposed to indicate significant psychological distress (Franke, 2000). Severity of PTSD symptoms was measured with the German version of the 20-item PTSD Checklist for DSM-5 (PCL-5; Krüger-Gottschalk et al., 2017). Total scores range from 0 to 80, with higher scores indicating more severe PTSD symptomatology. A total score of 37 has been recommended to indicate a probable PTSD diagnosis (Ashbaugh, Houle-Johnson, Herbert, El-Hage, & Brunet, 2016). Depressiveness was assessed using the 21-item revised version of Beck's Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996). Scores on the total scale range from 0 to 63, with higher scores reflecting more severe depressive symptoms. Criteria have been proposed to interpret the total score as reflecting mild (14–19), moderate (20–28), or severe (29–63) depression (Beck et al., 1996). The severity of SSD symptomatology was quantified using the 12-item Somatic Symptom Disorder-B Criteria Scale (SSD-12; Toussaint et al., 2016), with total scores ranging from 0 to 48, and higher scores indicating

higher psychological burden associated with somatic symptoms. A cutoff score of 23 has been suggested to indicate a probable SSD diagnosis (Toussaint, Hüsing, Kohlmann, & Löwe, 2020). In the current sample, all self-report questionnaires demonstrated excellent internal consistency with Cronbach's α ranging from .94 (SSD-12) to .97 (BSI).

Psychotropic medication load

Considering possibly confounding effects of medication, we calculated a standardized composite medication score following established procedures outlined in previous studies (for details, see Eckstrand et al., 2019; Hassel et al., 2008; Schwarz et al., 2020). Briefly, regularly prescribed daily doses of antidepressants, antipsychotics, and anticonvulsants (i.e., pregabalin) were each coded as absent (=0), low-dose (=1), or high-dose (=2) according to substance-specific criteria (Gardner, Murphy, O'Donnell, Centorrino, & Baldessarini, 2010; Sackeim, 2001; Serpell et al., 2017). Subsequently, all codes were summed up to calculate a composite measure of the number and dosage of psychotropic medication for each participant.

Theory of mind

We measured ToM using the multiple-choice version of the MASC (Dziobek et al., 2006; Wacker, Bölte, & Dziobek, 2017), a video-based test assessing the ability to accurately infer others' mental states. Participants watch a 15-min movie about four characters getting together for a dinner party. Participants are required to answer 45 multiple-choice questions about the characters' emotions, thoughts, and intentions at given breaks throughout the movie. Of the 45 multiple-choice questions, 18 questions measure emotional mental state decoding (i.e., affective ToM), whereas 27 questions measure decoding of others' thoughts and intentions (i.e., cognitive ToM). Participants answer each question by selecting one of four possible responses, encompassing mental state inferences that are (1) adequate (i.e., correct ToM), (2) exceeding (i.e., excessive ToM), (3) insufficient (i.e., less ToM), or (4) non-existent (i.e., no ToM, such as focusing on physical causation). Additionally, six control questions are administered assessing non-social inferencing to account for general intellectual functioning as a potential confound of ToM (Buhlmann et al., 2015).

We calculated the MASC total score assessing adequate mental state inferencing as the total number of correct responses to all ToM questions (range: 0–45). Moreover, we calculated MASC scores assessing adequate emotional or cognitive mental state inferencing as the proportion of correct responses to affective (i.e., affective ToM) or cognitive ToM questions (i.e., cognitive ToM). Furthermore, we calculated MASC scores assessing inadequate mental state inferencing as the total number of each of the three MASC error types (i.e., excessive ToM, less ToM, and no ToM). Finally, we calculated the MASC control score assessing non-social inferencing as the total number of correct responses to all control questions (range: 0–6).

Prior research has shown the MASC to be a reliable and sensitive tool for detecting subtle ToM impairments in individuals with and without mental disorders (e.g., Brockmeyer et al., 2016; Dziobek et al., 2006; Smeets, Dziobek, & Wolf, 2009). The psychometric properties of the MASC have been shown to be highly satisfactory, with a high internal consistency (Cronbach's α = .84), and an intraclass correlation coefficient (ICC) reflecting a high test–retest reliability (ICC = .97; Dziobek et al., 2006). Moreover, convergent results with a popular ToM paradigm, the Strange Stories Task (Happé, 1994),

further underscore the validity of the MASC as a measure of ToM ability (Dziobek et al., 2006).

Procedure

The study was approved by the Ethics Committee of the Medical Faculty of Heidelberg University, Heidelberg, Germany. After providing written informed consent, participants took part in three study visits, including diagnostic assessments, functional magnetic resonance imaging, and behavioral tasks. Participants were reimbursed for their participation.

Data analysis

Statistical analyses were performed with SPSS (version 26). For all statistical analyses, a significance threshold of $p < .05$, two-tailed, was set.

Prior to the main analyses, normal distribution for all variables of interest (i.e., MASC subscores, CTQ total score) was explored by examining skewness and kurtosis indices, and normality plots (Q–Q-plots) in each group. Outliers, defined as individuals with scores exceeding 3 *SD* of their subgroup's mean, were excluded. After excluding three outliers, MASC subscores and CTQ total scores were largely normally distributed, with the exception of MASC no ToM scores in the HV group. Thus, parametric tests are reported for all analyses.

First, we examined between-group differences in ToM performance using analyses of variance (ANOVAs). We applied the Huynh-Feldt procedure (Huynh & Feldt, 1976) to correct for potential violations of the sphericity assumption where indicated. We report partial eta-squared (η^2) as an effect size index. According to Cohen (1988), partial eta-squared values of .01, .06, and .14 are considered small, medium, and large effects, respectively. Significant effects were followed up by Dunn's Multiple Comparisons as *post-hoc* tests. Considering possibly confounding effects of medication, each ANOVA was repeated with psychotropic medication load (i.e., the standardized composite medication score) as a covariate.

Second, we investigated the transdiagnostic association between childhood trauma and ToM performance in the whole sample using Pearson correlation coefficients with Bonferroni correction for multiple comparisons.

Third, we explored the relationship between childhood trauma and ToM performance in each group using Pearson correlation coefficients. Follow-up comparisons of within-group correlations were calculated using Fisher z scores. Considering the exploratory nature of analyzing group-specific associations, Bonferroni correction for multiple comparisons was not applied.

Results

Is theory of mind impaired in individuals with mental disorders?

Means and standard deviations of all MASC scores by group are summarized in Table 2. The ANOVA with the MASC total score revealed a significant main effect of group for the overall ToM performance ($F[3,133] = 4.87, p = .003, \eta^2 = .10$). As depicted in Figure 1, *post-hoc* pairwise comparisons revealed a significantly worse performance only in individuals with PTSD compared to HVs ($p < .01$) and individuals with MDD ($p < .05$),

while individuals with MDD or SSD did not differ significantly from HVs or each other. The same picture emerged from the two mixed-design ANOVAs which revealed a significant main effect of group in both ToM type (F[3,133] = 4.83, p = .003, η^2 = .10) and error type (F[3,133] = 4.87, p = .003, η^2 = .10), but no significant group by ToM type (F[3,133] = 0.88, p = .453, η^2 = .02) or group by error type (F[6,266] = 0.74, p = .606, η^2 = .02) interaction. Additionally, the ANOVA with the MASC control score revealed no significant main effect of group for the non-social inferencing performance (F[3,133] = 0.95, p = .417, η^2 = .02). Repeating the analyses with medication (i.e., the standardized composite medication score) as a covariate did not change the pattern of significant results. Thus, the current results suggest that individuals with PTSD, but not individuals with MDD or SSD, demonstrate significant ToM impairments compared to HVs. These impairments appear to be independent of ToM type (i.e., affective ToM, cognitive ToM), error type (i.e., excessive ToM, less ToM, and no ToM), non-social inferencing, and current psychotropic medication.

Is childhood trauma associated with theory of mind transdiagnostically?

As shown in Figure 2a, correlation analyses revealed a negative association between childhood trauma (i.e., CTQ total score) and overall ToM performance (i.e., MASC total score) in the whole sample, $r = -.25$, $p = .003$. Subsequent analyses showed negative associations between childhood trauma and both affective ToM questions, $r = -.26$, $p = .003$, and cognitive ToM questions, $r = -.17$, $p = .045$. Considering the Bonferroni-corrected alpha level of .008, only the association between childhood trauma and affective ToM questions may be considered significant. Moreover, no significant association emerged between childhood trauma and each of the three error types (i.e., excessive ToM, $r = .21$, $p = .016$; less ToM, $r = .19$, $p = .030$; no ToM, $r = .10$, and $p = .253$).

Is childhood trauma associated with diagnosis-specific theory of mind impairments?

As indicated in Table 3, exploratory analyses of the relationships between childhood trauma (i.e., CTQ total score) and ToM performance (i.e., MASC subscores) in each of the four groups yielded a moderate positive correlation between childhood trauma and excessive ToM errors only in individuals with SSD, $r = .36$, $p = .031$, but not in the other groups (all $|r| \leq .20$, $p \geq .275$). Follow-up comparisons of within-group correlations using Fisher z scores revealed significant group differences in the association between childhood trauma and different aspects of ToM performance: Among individuals with PTSD, those with higher levels of childhood trauma showed a worse overall ToM performance, while in the MDD group, those with higher levels of childhood trauma showed a better overall ToM performance ($z = -1.95$, $p = .026$; see Figure 2b). This group difference between individuals with PTSD and MDD was found particularly with regard to cognitive ToM questions ($z = -1.85$, $p = .032$). Furthermore, among individuals with SSD, higher childhood trauma scores were associated with more excessive ToM errors, whereas in the MDD group, higher childhood trauma scores were associated with less of those errors ($z = 2.08$, $p = .019$). Finally, among individuals with SSD, higher levels of childhood trauma were associated with fewer 'less ToM' errors, as compared to individuals with PTSD ($z = -1.88$, $p = .030$) and HVs ($z = -1.97$, $p = .025$) who made more of those errors with higher levels of childhood trauma.

Discussion

The current study sought to better understand ToM disturbances in different mental disorders and their association with childhood trauma. Our results suggest ToM impairments in individuals with PTSD, but not in individuals with MDD or SSD compared to HVs. Furthermore, our results point towards transdiagnostic and diagnosis-specific associations between childhood trauma and ToM alterations, possibly indicating differential effects of childhood trauma on ToM performance in different types of adult psychopathology.

Using the MASC as an ecologically valid measure of inferring others' mental states, we found a poorer overall ToM performance in individuals with PTSD compared to HVs and individuals with MDD. Our result is in line with two meta-analyses, reporting ToM impairments in individuals with PTSD compared to non-clinical controls (Plana et al., 2014; Stevens & Jovanovic, 2019). Moreover, our result is consistent with Preißler et al. (2010), who found individuals with borderline personality disorder (BPD), particularly those with comorbid PTSD, to perform worse on the MASC than HVs. Thus, individuals with PTSD may be impaired in interpreting others' mental states while observing their social interactions from a third-person perspective.

Contrary to our expectations, we did not find significant differences between individuals with MDD or SSD and HVs on the MASC. Instead, MASC total scores of individuals with MDD and SSD lied somewhere in between those of individuals with PTSD and HVs. Notably, individuals with MDD presented with significantly higher MASC total scores compared to individuals with PTSD ($p < .05$), while individuals with SSD did not differ significantly from any of the other three groups ($p > .05$). Our results stand in contrast to prior studies which indicate ToM deficiencies in both individuals with MDD (Bora & Berk, 2016; van Neerven et al., 2021) and SSD (Subic-Wrana et al., 2010; Zunhammer et al., 2015) compared to HVs. Our results are particularly unexpected considering that studies that also applied the MASC demonstrated ToM deficits in individuals with MDD (Wolkenstein et al., 2011; Zwick & Wolkenstein, 2017) and persistent somatoform pain disorder (PSPD; Schönenberg et al., 2014), a disorder which is subsumed among the recently introduced DSM-5 diagnosis of SSD (Dimsdale et al., 2013). Discrepancies between current and earlier findings may be explained by the clinical characteristics of our sample. With regard to individuals with MDD, our findings correspond to a prior study in which the MASC also failed to detect ToM impairments in individuals with early-onset chronic depression compared to HVs (Wilbertz et al., 2010). Exploring the age of MDD onset in our sample, we found that 25 out of 33 individuals with MDD (75.8%) reported their first depressive episode before the age of 21 and thus an early-onset MDD. Additionally, HVs in our study and the one by Wilbertz et al. (2010) indicated on average moderate degrees of childhood trauma. Consequently, it may be assumed that individuals with (predominantly) early-onset MDD and HVs with moderate levels of childhood trauma are equally capable of adequately inferring others' mental states from a third-person perspective. Our MDD sample, however, contains only 8 individuals with late-onset MDD and thus does not allow to examine subgroup differences between early- versus late-onset MDD. The question regarding whether individuals with early-onset MDD represent a distinct subtype without considerable ToM impairments hence warrants further investigation in future studies. With regard to individuals with SSD, inconsistencies with prior research using the MASC (Schönenberg et al., 2014) may be explained by heterogeneous diagnostic criteria of PSPD and SSD as well as the participants' somatic symptom burden. Since Schönenberg et al. (2014) do not report their sample's somatic

symptom burden, it remains unclear whether this characteristic contributes to ToM impairments in individuals with SSD. Given that ToM impairments have so far been found solely in hospitalized patients with somatoform disorders (Schönenberg et al., 2014; Subic-Wrana et al., 2010; Zunhammer et al., 2015), however, it could be assumed that only individuals with severe SSD demonstrate marked ToM deficits

Analyzing the association between childhood trauma and ToM performance in the whole sample, higher levels of childhood trauma turned out to be significantly associated with lower scores in overall ToM performance. Our findings replicate prior research, demonstrating associations between childhood trauma and ToM impairments in clinical and general population samples (e.g., Brüne, Walden, Edel, & Dimaggio, 2016; Duque-Alarcón et al., 2019; Germine et al., 2015; Huang et al., 2020; Kvarstein et al., 2020; Li et al., 2020; Vaskinn et al., 2020; but see Hillmann et al., 2020, for inconsistent results). So far, however, studies have been limited by relying on self-report measures or static cartoon-based tasks to assess ToM capacities and/or by examining only one clinical group, particularly BPD patients, compared to one healthy control group. Our study extends these findings by measuring ToM abilities with a video-based task capturing the characteristics of everyday social interactions in a more dynamic and ecologically more valid way in a large, transdiagnostic sample. Interestingly, in the whole sample, the negative association between childhood trauma and ToM performance was only significant for affective ToM questions, but not for cognitive ToM questions. This result aligns with stronger associations between childhood trauma and affective ToM compared to cognitive ToM found in individuals with BPD (Brüne et al., 2016) and schizophrenia (Vaskinn et al., 2020). Of note, in the whole sample, no significant correlation between childhood trauma and ToM error types emerged. Previous studies using the MASC and targeting the association between childhood trauma and ToM error types have been mixed, indicating fewer ToM errors (i.e., 'hypomentalizing') with higher childhood trauma levels in individuals with BPD and HVs (Duque-Alarcón et al., 2019), or no significant association in individuals with schizophrenia and HVs (Vaskinn et al., 2020). More transdiagnostic studies investigating individuals with and without different mental disorders are needed to disentangle inconclusive findings.

Table 2. Performance on the Movie for the Assessment of Social Cognition by group

	PTSD (n = 33)		MDD (n = 33)		SSD (n = 36)		HVs (n = 35)	
MASC subscores	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Total score	33.42	4.85	36.15	3.59	35.64	3.46	36.74	3.15
ToM type								
Affective ToM	13.52	2.55	14.48	1.81	14.75	1.44	14.83	1.86
Cognitive ToM	19.91	2.94	21.67	2.69	20.89	2.82	21.91	2.22
Error type								
Excessive ToM	5.45	2.36	4.21	2.23	4.22	2.03	4.37	2.44
Less ToM	4.00	2.44	3.33	1.56	3.56	1.72	2.66	1.63
No ToM	2.12	1.58	1.30	1.43	1.58	1.61	1.23	1.68
Control score	4.73	1.18	4.91	0.95	4.97	0.88	5.11	0.80

Note. Data are presented as total number of responses in the respective MASC subscore category. HVs, healthy volunteers; MASC, Movie for the Assessment of Social Cognition; MDD, major depressive disorder; PTSD, posttraumatic stress disorder; SSD, somatic symptom disorder; ToM, theory of mind.

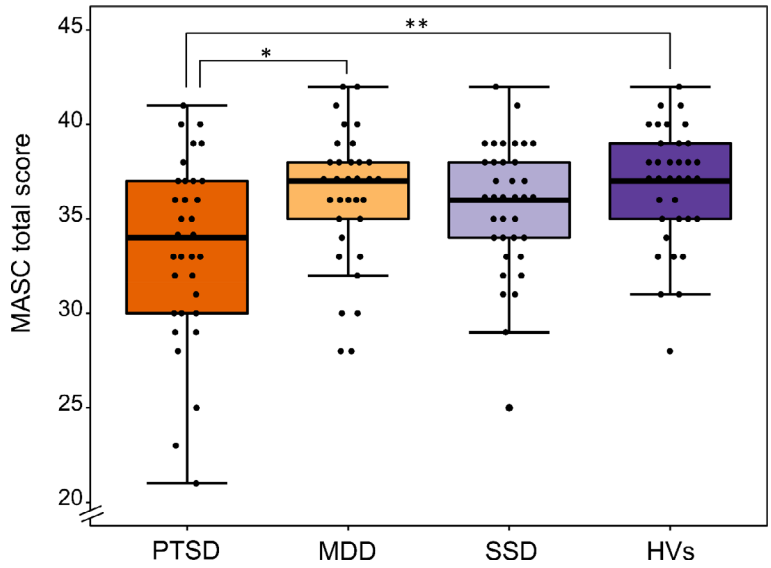

Figure 1. Overall performance on the Movie for the Assessment of Social Cognition in individuals with posttraumatic stress disorder, major depressive disorder, somatic symptom disorder, and healthy volunteers. *Note.* Individuals with posttraumatic stress disorder performed significantly worse than individuals with major depressive disorder and healthy volunteers on the MASC. HVs, healthy volunteers; MASC, Movie for the Assessment of Social Cognition; MDD, major depressive disorder; PTSD, posttraumatic stress disorder; SSD, somatic symptom disorder. *$p < .05$, **$p < .01$.

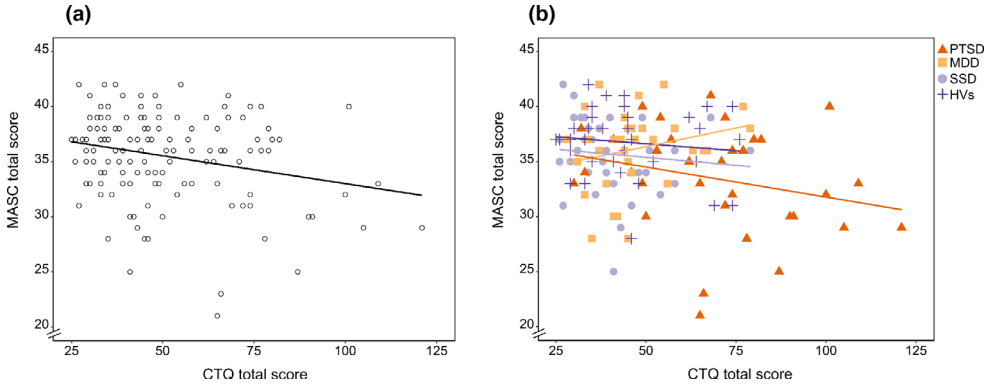

Figure 2. Transdiagnostic and group-specific correlations between childhood trauma and overall performance on the Movie for the Assessment of Social Cognition. *Note.* In panel (a), the scatterplot depicts the correlation in the whole transdiagnostic sample. In panel (b), the scatterplot depicts the correlations separately for individuals with posttraumatic stress disorder, major depressive disorder, somatic symptom disorder, and healthy volunteers. CTQ, Childhood Trauma Questionnaire; HVs, healthy volunteers; MASC, Movie for the Assessment of Social Cognition; MDD, major depressive disorder; PTSD, posttraumatic stress disorder; SSD, somatic symptom disorder.

Exploring the correlations between childhood trauma and indicators of ToM performance in each group separately pointed towards a significant association between

higher levels of childhood trauma and more excessive ToM errors only in individuals with SSD, but not in the other groups. Noteworthy, the only prior MASC study in SSD found a worse overall ToM performance, particularly a pronounced tendency to make more excessive ToM errors in individuals with SSD compared to HVs (Schönenberg et al., 2014). Since the DSM-5 diagnosis of SSD is characterized by excessive psychological reactions to one or more distressing somatic symptoms (Toussaint, Hüsing, Kohlmann, Brähler, & Löwe, 2021), it appears plausible that this excessiveness is also mirrored in the tendency of individuals with SSD to overattribute mental states to others. Considering prior and present findings, low emotional awareness (Schönenberg et al., 2014) and higher levels of childhood trauma may contribute to this 'hypermentalizing' bias and may be taken into consideration as potential confounds when examining ToM performance in SSD. Given the limited sample size of each of the four groups, however, diagnosis-specific conclusions should be made with caution and warrant replication in future investigations.

Subsequent comparisons of within-group correlations yielded a particularly unexpected result: while among individuals with PTSD, those with higher levels of childhood trauma scored lower on the MASC, among individuals with MDD, those with higher levels of childhood trauma scored higher on the MASC (i.e., total score and cognitive ToM). Our findings contradict prior evidence for childhood trauma impairing ToM capacities in MDD (Rnic et al., 2018; Simon et al., 2019). Such inconsistent findings may be explained by differences in the ToM process of interest and varying degrees of task complexity. The aforementioned studies (Rnic et al., 2018; Simon et al., 2019) used the Reading the Mind in the Eyes Test (RMET; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) to assess the ability to decipher others' mental states based on their eye gaze. Thus, both studies focused on basic ToM decoding. The current study, however, focused on ToM reasoning. Using the MASC, the current study measured the ability to interpret others' mental states by integrating more complex contextual social information. While the RMET only assesses first-order ToM, the MASC targets both first- and second-order ToM, reflecting a higher degree of task complexity. Based on our findings, it may be assumed that in individuals with MDD, childhood trauma only impairs ToM decoding but not ToM reasoning, including first- and second-order mental state inferencing. Moreover, prior research indicates differential effects of different types of childhood trauma on ToM performance, with early experiences of emotional or physical abuse impairing, but early experiences of

Table 3. Correlations between childhood trauma and theory of mind performance within each group

	CTQ total score			
	PTSD (n = 33)	MDD (n = 33)	SSD (n = 36)	HVs (n = 35)
MASC total score	–.26	.24	–.10	–.12
MASC affective ToM	–.19	.15	–.15	–.25
MASC cognitive ToM	–.26	.21	–.05	.04
MASC excessive ToM	.20	–.15	.36*	–.03
MASC less ToM	.26	–.11	–.21	.27
MASC no ToM	.10	–.24	–.01	–.01

Note. No correction for multiple comparisons was applied. CTQ, Childhood Trauma Questionnaire; HVs, healthy volunteers; MASC, Movie for the Assessment of Social Cognition; MDD, major depressive disorder; PTSD, posttraumatic stress disorder; SSD, somatic symptom disorder; ToM, theory of mind.
*$p < .05$.

neglect enhancing ToM performance in depressed and non-depressed individuals (Rnic et al., 2018). By exploring the correlations between the MASC total score and CTQ subscale scores in our MDD group, we found yet another inconsistent result with a moderate positive association emerging only for emotional abuse ($r = .33, p = .064$), but not for the other CTQ subscales ($|r| \leq .20, p \geq .275$). One intriguing, yet speculative interpretation of our findings could be that individuals with MDD and a history of emotional abuse become more sensitive towards interpersonal cues and thus better at inferring others' (cognitive) mental states. Enhanced ToM might, however, turn out to be a factor increasing risk rather than resilience in the transition to adulthood in vulnerable individuals. Prospective, large-scale studies are thus needed to clarify the complex impact of different types of childhood trauma on different aspects of ToM performance in MDD.

Our findings should be interpreted in the context of some limitations: First, individuals with PTSD scored significantly higher than the other groups on every CTQ subscale. It thus remains inconclusive whether PTSD diagnosis, higher levels of childhood trauma, or their interaction contributed to the worse ToM performance shown only by individuals with PTSD, but not individuals with MDD or SSD compared to HVs. Second, our cross-sectional design precludes causal inferences. Transdiagnostic and diagnosis-specific associations between childhood trauma and ToM impairments hence require replication in future longitudinal studies. Given the low agreement between retrospective and prospective measures of childhood trauma (Baldwin, Reuben, Newbury, & Danese, 2019), examining whether prospectively identified individuals with childhood trauma also show ToM deficiencies in adulthood will be of particular interest. Third, our diagnostic group allocation was based on the current diagnosis which needed to be assigned as the participant's first-lifetime disorder. Since we did not assess the interrater reliability for determining the onset of each mental disorder, it remains unclear how robust our diagnostic group allocation was. However, Table 1 shows that, despite high comorbidity rates, individuals with a current and first lifetime PTSD, MDD, or SSD indicated on average the highest sum score in the respective diagnosis-specific self-report questionnaire (i.e., PCL-5 for PTSD, BDI-II for MDD, and SSD-12 for SSD). Moreover, individuals allocated to the PTSD, MDD, or SSD group reported on average sum scores above the proposed clinical cutoff score only for the questionnaire which targeted their current and first-lifetime clinical diagnosis, but not for the questionnaires which targeted the other diagnoses. Fourth, our sample reported high comorbidity rates, specifically among the three disorders of interest (i.e., PTSD, MDD, and SSD). While high comorbidity rates are a common finding in the childhood trauma literature (Scott, Smith, & Ellis, 2010) and thus emphasize the representativeness of our sample, they can make the interpretation of findings more complex. To account for these high comorbidity rates, we conducted a sensitivity analysis by removing all individuals from our sample who fulfilled more than one diagnosis of interest at the time of study participation. Removing individuals with current comorbid diagnoses of interest did not change the overall significance or direction of our results and thus highlight the robustness of our findings (please refer to the Supporting Information for further details). Fifth, although the association between childhood trauma and dissociation is well-documented in the literature (Vonderlin et al., 2018), and dissociation has been reported to impair ToM capacities (Schimmenti, 2016), we did not assess dissociative experiences immediately before administering the MASC. Future studies should measure dissociation before assessing ToM performance to control for dissociation impacting the ability to infer others' mental states. Sixth, we were unable to investigate the specific effects of any childhood trauma subtype without potential contamination of the effects of other

childhood trauma subtypes due to the high rates of exposure to more than one childhood trauma subtype in the whole sample (see Supporting Information). Seventh, considering previous reports of female superiority in ToM abilities (Abu-Akel & Bo, 2013; Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997), the disproportionate number of female participants in our sample might overestimate ToM performance of individuals of male or non-binary gender. Finally, although our results indicate that clinical characteristics (e.g., MDD subtype, inpatient status, and childhood trauma type) may be relevant for ToM impairments, our limited sample size, particularly in each of the four groups, does not allow for conducting subgroup analyses. Future studies with larger samples are thus needed to advance our understanding of the impact of different types of childhood trauma and psychopathology on adult ToM performance.

Taken together, this is the first study, to the best of our knowledge, to reveal transdiagnostic and diagnosis-specific associations between childhood trauma and ToM impairments in individuals with and without common mental disorders. Provided replication in future studies, ToM capacities may be considered a promising treatment target for individuals with a history of severe childhood trauma, at least or particularly with a diagnosis of PTSD.

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Conflicts of interest

All authors declare no conflict of interest.

Author contribution

Katja I. Seitz: Conceptualization (equal); Data curation (equal); Formal analysis (equal); Investigation (equal); Software (equal); Visualization (equal); Writing – original draft (equal); Writing – review & editing (equal). **Nicola Ehler:** Data curation (equal); Investigation (equal); Writing – review & editing (equal). **Marius Schmitz:** Investigation (equal); Writing – review & editing (equal). **Sara E. Schmitz:** Investigation (equal); Writing – review & editing (equal). **Isabel Dziobek:** Methodology (equal); Writing – review & editing (equal). **Sabine C. Herpertz:** Conceptualization (equal); Funding acquisition (equal); Resources (equal); Supervision (equal); Writing – review & editing (equal). **Katja Bertsch:** Conceptualization (equal); Formal analysis (equal); Funding acquisition (equal); Resources (equal); Supervision (equal); Writing – review & editing (equal).

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Supporting Information

The following supporting information may be found in the online edition of the article:

S1. Sensitivity analysis, Transdiagnostic association between childhood trauma subtypes and theory of mind.