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Ambulatory assessment of mechanisms underlying interpersonal dysfunction in individuals with a history of childhood maltreatment

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Betreut durch apl. Prof. Dr. Inga Niedtfeld

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Publikation 1 Autor/innen: **Schmitz, S. E.**, Hepp, J., Lane, S. P., Niedtfeld, I.; Titel: The effect of momentary mood on appraisal of facial affect and distrust: An experimental approach using ambulatory assessment; Zeitschrift: Cognition and Emotion; Impact factor: 2.72; Status: publiziert; Original-Forschungsarbeit

Publikation 2 Autor/innen: **Schmitz, S. E.**, Niedtfeld, I., Lane, S. P., Seitz, K. I., Hepp, J.; Titel: Negative affect provides a context for increased distrust in the daily lives of individuals with a history of childhood maltreatment; Zeitschrift: Journal of Traumatic Stress; Impact factor: 3.952; Status: publiziert; Original-Forschungsarbeit

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Preface

Both publications are based on a project (B1, PI Niedtfeld) within a Research Training Group (RTG) on the consequences of adverse childhood experiences (Graduiertenkolleg 2350, GRK2350), which was funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG).

Publication 1: The effect of momentary mood on appraisal of facial affect and distrust: An experimental approach using ambulatory assessment (Chapter II). *Conceptualization:* Under supervision of I. Niedtfeld, I conceptualized the study design (80%). I set up the methods of the study (e.g., recruitment of participants, questionnaires, participant information, and consent), and programmed and tested the app for the assessment in daily life in Movisens XS (100%). *Literature search:* I did all relevant literature search for this publication (100%). *Ethics approval:* Under supervision of I. Niedtfeld, I wrote the ethics application, which applies to both studies (90%). *Data collection:* I performed recruitment and diagnostic interviews for all study participants and the administration (100%). *Examination of study data:* I analyzed the data of the study under supervision and with support of J. Hepp and S.P. Lane (70%). *Interpretation of the data:* I interpreted the results of the multi-level models under supervision of J. Hepp and S.P. Lane (80%). *Manuscript writing:* I wrote the first draft of the paper manuscript (80%), and the co-authors were involved in *editing of the manuscript* text. *Revision of the manuscript:* I completed the main part of the revision for publication (90%), and the co-authors were involved in editing the revised manuscript. *Tables and figures*: I created all tables and figures of this publication (100%).

Publication 2: Negative affect provides a context for increased distrust in the daily lives of individuals with a history of childhood maltreatment (Chapter III). *Conceptualization:* Under supervision of I. Niedtfeld, I conceptualized the study design (80%). I set up the methods of the study (e.g., recruitment of participants, questionnaires, participant information, and consent), and programmed and tested the app for the assessment in daily life in Movisens XS (100%). *Literature search:* I did all relevant literature search for this publication (100%). *Data collection:* I performed recruitment and diagnostics of study participants and did the administration in collaboration with other projects of the GRK (60%). *Examination of study data:* I analyzed the data of the study under supervision and with support of J. Hepp and S.P. Lane (70%). *Interpretation of the data:* I interpreted the results of the multi-level models under supervision of J. Hepp and S.P. Lane (80%). *Manuscript writing:* I wrote the first draft of the paper manuscript (80%), and the other co-authors were involved in *editing of the manuscript* text. *Revision of the manuscript:* I did the main part of the revision for publication (90%), and the co-authors were involved in editing the revised manuscript. *Tables and figures*: I created tables and figures of this publication with support of J. Hepp and S.P. Lane (80%).

Abbreviations

AA	Ambulatory assessment
BPD	Borderline Personality Disorder
CM	Childhood maltreatment
CTQ	Childhood Trauma Questionnaire
CTS	Childhood Trauma Screener
CPT	Cognitive Processing Therapy
DBT	Dialectical Behavior Therapy
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5th edition
DSS-4	Dissociation Tension Scale
Est.	Model estimate
ICC	Intraclass correlation coefficients
IPDE	International Personality Disorder Examination
MCM	Mood-congruent memory
MLM	Multi-level model
PANAS-X	Positive and Negative Affect Schedule, Extended Version
PTSD	Posttraumatic Stress Disorder
SCID-I	Structured Clinical Interview for DSM–IV Axis I disorders
SUD	Substance Use Disorder
WHO	World Health Organization

Theoretical Background

CHAPTER I

1.1 Childhood Maltreatment

Childhood maltreatment (CM) is highly prevalent and has deleterious long-term consequences on physical and mental health (Bellis et al., 2019; Leeb et al., 2008; Nurius et al., 2015). CM includes "the physical, sexual, mental abuse and/or neglect of children younger than 18 years" (p.8; Sethi et al., 2018). Whereas child abuse involves words or actions that are used intentionally and cause harm to a child, child neglect involves the failure to provide for a child's basic physical or emotional needs or to protect a child from harm (Leeb et al., 2008). Research has demonstrated that experiencing CM of any type can have devastating consequences on development (e.g., Bolger et al., 2008; Widom, 1999a).

CM is highly prevalent in the general population, however prevalence rates vary considerably due to different definitions, different types of CM, methodological factors (e.g., self-report vs. informant studies), and continent and gender (see Moody et al., 2018 for a review). Prevalence rates for sexual abuse, which is the most commonly studied type of CM worldwide, range from 6 to 27% depending on the continent (Moody et al., 2018). When considering gender, prevalence rates for sexual abuse were consistently higher for females than for males, except in South America and Asia. Prevalence rates for physical abuse vary across continents and range from 22 to 60%, with higher prevalence rates for males in European studies. Emotional abuse exhibits prevalence rates ranging from 6 to 61%, with mixed findings in terms of gender. Neglect shows prevalence rates varying from 17 to 65%, with predominantly similar or higher prevalence rates for females than for males (Moody et al., 2018).

Research on CM has identified numerous severe and acute consequences, such as death and injury, but also detrimental long-term outcomes such as anxiety, conduct disorder, aggression, delinquency, depression, increased risk for suicide, interpersonal problems, poor physical health, risky health behavior, and youth violence (see Hughes et al., 2017 for a review). CM increases

the risk for mental disorders and behavioral dysfunction, not only during childhood but also throughout adolescence and adulthood (Green et al., 2010; Kessler et al., 2010; McLaughlin et al., 2010). Accordingly, there is a heightened prevalence of psychopathology among individuals with a history of CM (e.g., Carr et al., 2020; Witt et al., 2019). Research exploring the role of cumulative CM for health-related outcomes has shown that the various types of CM often co-occur, leading to an elevated risk of more severe and complex psychopathology in a dose-response relation (i.e., as the number of types of CM increases) (Clemmons et al., 2007; Green et al., 2010; Hughes et al., 2017; McLaughlin et al., 2010; Schneider et al., 2007; Vranceanu et al., 2007). Moreover, CM is predictive of poorer psychosocial functioning and socioeconomic status later in life (Herzog & Schmahl, 2018). Hence, adults with a history of CM report impairments in various domains of social functioning, such as less adaptive relationships, increased loneliness and social isolation, higher rates of separation and divorce, and problematic parenting behaviors (Labella et al., 2018; Pfaltz et al., 2022; Savage et al., 2019; Shevlin et al., 2015; White & Widom, 2003; Zamir, 2022). Poor social functioning and a lack of social support, in turn, increase the risk for the development of mental disorders (DuMont et al., 2007). Additionally, it has been consistently observed that a history of CM is associated with atypical physiological responses to stress (Heleniak et al., in press; McLaughlin et al., 2014) and neurobiological changes (Moreno-López et al., 2020; Wang et al., 2018). Related to the numerous consequences for physical and mental health, the economic consequences of CM are ample and create a high burden on health care systems. While the estimated annual US population economic burden of CM is USD 428 billion, the estimated per-victim lifetime cost in the US is USD 830,928 (Peterson et al., 2018).

Beyond increasing the risk for psychopathology in general, there is ample evidence that CM plays an important role in the etiology of Posttraumatic Stress Disorder (PTSD, e.g., Dvir et al., 2014; Kessler et al., 2017; Perrin et al., 2014). PTSD, as defined in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), is a debilitating mental disorder that causes significant impairments in social and professional functioning (Scoglio et al., 2022).

PTSD is characterized by intrusive, recurrent thoughts of the traumatic event, avoidance of reminders of the event, and a state of hyperarousal and impaired emotional responsiveness (American Psychiatric Association, 2013). In addition, individuals with PTSD may perceive the world to be dangerous, view their social environment as a threat to their safety, and avoid social interactions in order to increase their perceived safety (Resick & Schnicke, 1993). Moreover, individuals with PTSD frequently experience anxiety and irritability in social situations (Hagan et al., 2019; Kelly et al., 2020). These emotional responses might be triggered by perceived threat from others, or from social environments (Gardner & Moore, 2008). These symptoms can result in reduced social functioning, social isolation, and can eventually increase the risk of suicide (Martin et al., 2009; Panagioti et al., 2014), which again underlines the severity of the disorder. Lifetime prevalence of PTSD is estimated to be 7.8%, with higher rates in women than in men (de Vries & Olff, 2009; Direk & Tiemeier, 2010; Kessler et al., 2005; Marshall et al., 2010). The risk for the development of PTSD following exposure to traumatic events is influenced by several factors, including the specific type of trauma experienced (McLaughlin & Lambert, 2017). A history of CM, particularly cumulative or chronic CM, is associated with increased rates of PTSD (30% to 38%; Widom, 1999b) and a more severe and complex pattern of psychopathology. This includes the presence of complex Posttraumatic Stress Disorder (complex PTSD), as well as comorbidities such as Eating Disorders, Substance Use Disorders (SUD), and Borderline Personality Disorder (BPD; Messman-Moore & Bhuptani, 2017). Specifically, individuals with a history of CM often exhibit pronounced difficulties in interpersonal relationships, distinguishing them from individuals with adult-onset trauma (Browne & Finkelhor, 1986; Cloitre et al., 1997; Zlotnick et al., 1996).

In sum, CM has devastating consequences and plays an important role in the etiology of mental disorders, such as PTSD. Empirical evidence from both developmental and adult literature consistently highlights the substantial impact of CM on fundamental lifelong patterns of interpersonal relating, which are crucial for later role performance. However, the scarcity of

studies aiming to identify the specific underlying processes leading to these impairments, and ultimately the development of mental disorders, hinders the development of effective preventative and therapeutic interventions.

The purpose of this thesis was therefore to identify possible transdiagnostic mechanisms underlying interpersonal dysfunction among individuals with a history of CM. By directly examining specific biases in social information processing within the context of daily life experiences, I have intended to contribute to a better understanding of factors that could be targeted by future interventions with the goal of improving interpersonal functioning in individuals with a history of CM. In the following section, I introduce and discuss potentially relevant social information processing mechanisms before I address additional factors that may influence the manifestation of these alterations within a specific situation. After describing previous research (and research gaps) in this field, I will derive my research aims and provide a detailed outline.

1.2 Social-Cognitive Alterations in Individuals with a History of CM

Although numerous studies demonstrate significant interpersonal dysfunction and a heightened prevalence of mental disorders in children and adults that were exposed to CM, knowledge on possible mechanisms that could explain these associations is limited. However, in light of the deleterious long-term consequences and high prevalence rates of CM, it is central to gain a better understanding of the underlying factors. Processes that were shown to be affected by CM span social, emotional and biological domains (e.g., McLaughlin et al., 2020; McLaughlin & Lambert, 2017). Specifically, alterations in social-cognitive processes have been found to be relevant for the interpersonal functioning of individuals with a history of CM (Pfaltz et al., 2022). In the following, I will briefly outline existing theories and empirical evidence pertaining to this domain.

According to a current transdiagnostic model, social-cognitive processes are one of the central mechanisms linking CM to multiple forms of psychopathology (McLaughlin et al., 2020; McLaughlin & Lambert, 2017). The model particularly posits that the experience of CM predisposes individuals to exhibit biases in the perception, identification, and interpretation of social cues, thereby facilitating a rapid identification of environmental threats. Empirical evidence spanning various domains of social information processing supports this notion, indicating that children with a history of CM display biases that prioritize the identification of potentially threatening social cues and that they are prone to perceiving such cues as threatening (Dodge et al., 1995; Pollak et al., 2000; Pollak & Kistler, 2002). Although the prioritization of threat-related information may initially help children to identify early signals of danger in environments where danger has been previously encountered, it can become maladaptive when applied rigidly, even in objectively safer interpersonal contexts (Cicchetti et al., 2000; Crick & Dodge, 1994; Pollak, 2003). In this context, it has been found that the sensitivity to threat increases with the level of CM experienced (Pollak et al., 2009). Furthermore, it has been observed that this heightened threat sensitivity persists into adulthood (Gibb et al., 2009), suggesting that the development of relatively stable information processing biases is common among individuals with a history of CM.

In line with this, cognitive models of PTSD (Janoff-Bulman, 1989; Resick & Schnicke, 1993) can provide further insights into the alterations observed in social-cognitive processes. According to these theories, biases in the perception and interpretation of social cues might stem from underlying beliefs that have been formed in the context of traumatic life experiences. Following traumatic experiences such as CM, fundamental beliefs or schemas about the self, the world and other people are believed to undergo a negative shift, to give an explanation of the traumatic event (e.g., McCann et al., 1988). McCann and her colleagues (McCann & Pearlman, 1990; McCann et al., 1988) propose five core areas of the belief system that are frequently affected by traumatic experiences: trust (e.g., ‘I can trust no one’), safety/threat (e.g., ‘Most people and contexts are dangerous’), power (e.g., ‘I have no control over what happens to me’), self-regard

(e.g., ‘I am forever changed’), and intimacy (e.g., ‘I cannot be close to anyone’) (McCann et al., 1988; Resick & Schnicke, 1993). Given the specific aspects of interpersonal trauma such as CM, it is possible that certain cognitive schemas are particularly salient in those affected. As outlined above, individuals with a history of CM frequently exhibit high levels of interpersonal threat sensitivity (Dodge et al., 1995; Pollak et al., 2000; Pollak & Kistler, 2002). These, in turn, are associated with specific response patterns, such as avoidant or phobic responses, or social withdrawal (McCann et al., 1988), and may eventually contribute to the described impairments in interpersonal functioning (Nelson et al., 2002; Pfaltz et al., 2022).

In addition to safety concerns, victims of interpersonal trauma such as CM frequently display a general mistrust towards other people (e.g., Blanchard-Dallaire & Hébert, 2014; Botsford et al., 2019; Pepin & Banyard, 2006; Vaile Wright et al., 2010). However, trust is fundamental to effectively manage relationships and create cooperative interactions (e.g., Chouliara et al., 2020; Williams et al., 2014). Developed during childhood, the ability to trust allows individuals to risk and enjoy experiences such as interactions with others (Bernath & Feshbach, 1995). Trust is defined as “a psychological state comprising the intention to accept vulnerability based upon the positive expectations of the intentions or behavior of another” (p. 395; Rousseau et al., 1998). Existing trust schemas are particularly threatened if the perpetrator was formerly trusted and relied on by the victim (Vaile Wright et al., 2010), which is typical for CM. If, consequently, those affected by CM approach others with suspiciousness and avoidance, this, in turn, prevents that others can prove trustworthy, presumably contributing to relationship difficulties (McCann & Pearlman, 1990).

The cognitive alterations described above have been proposed primarily for severe types of trauma, involving a threat to life or well-being. Accordingly, negative alterations in cognitions are also part of a PTSD diagnosis following DSM-5 (American Psychiatric Association, 2013). In criterion D of the PTSD diagnosis, these are described as “persistent and exaggerated negative beliefs or expectations about oneself, others, or the world (e.g., “I am bad”, “No one can be

trusted", "The world is completely dangerous", "My whole nervous system is permanently ruined")" (American Psychiatric Association, 2013). To date, it is unclear whether CM, which also includes experiences that are not necessarily life-threatening (e.g., in the case of emotional neglect), might lead to similar negative beliefs.

Knowledge of increased interpersonal threat perception and distrust in individuals with a history of CM could be of high relevance, for example for the therapeutic relationship or the selection of interventions, particularly when patients are in treatment for another than a trauma-related diagnosis. Moreover, negative cognitions surrounding these two areas seem highly relevant for interpersonal functioning and psychosocial integration (see Carr et al., 2020). It is for these reasons that I have chosen to focus on interpersonal threat sensitivity and distrust within this thesis.

Previous work on increased interpersonal threat sensitivity and distrust in individuals with a history of CM has revealed mixed results. Researchers have been measuring interpersonal threat sensitivity by capturing participants' reactions to negative facial expressions. Tasks that have been used for this purpose include visual attention tasks (e.g., Seitz et al., 2021) and emotion rating tasks (e.g., Bell et al., 2017), all of which use pictures of emotional faces as potentially threat-inducing stimuli. In these tasks, different emotional expressions such as fear, sadness, anger or disgust are used (e.g., Bell et al., 2017; Bertsch et al., 2017; Chu et al., 2016; Cowden Hindash et al., 2019; Fonzo et al., 2010; Seitz et al., 2021), which can signal potential threat in the environment, or by the displayed person itself. Most studies also included either positive (happy/joyful) or neutral expressions. Those studies showed that CM was associated with over-attributing anger, fear, and contempt to neutral faces (Catalana et al., 2020; Pfaltz et al., 2019), and with misclassifying emotional and neutral faces as angry (Seitz et al., 2021).

In a previous study of our own working group (Hepp et al., 2021), we included 549 participants with varying levels of CM, assessed by the Childhood Trauma Questionnaire (CTQ; Bader et al., 2009; Bernstein et al., 1998). In this web-based study, we presented participants with

60 faces displaying angry, fearful and happy expressions of varying intensities, and asked them to rate these emotional expressions on a scale from "very negative" to "very positive". Supporting our hypotheses, we found that higher levels of CM were associated with more negative evaluations of angry and fearful faces (Hepp et al., 2021). By calculating difference scores, substracting the actual intensity score of the stimulus from the rating of the participants, we were able to obtain an outcome that represents positive or negative shifts in the ratings. Participants with higher levels of CM showed stronger negative shifts and, thus, perceived facial stimuli more negatively and threatening than they actually were. Hence, we established a stimulus set and already demonstrated a cross-sectional association between varying levels of CM and perceived interpersonal threat sensitivity in a large web-based study.

Contradicting these results, another study found no differences in fear processing between individuals with PTSD (n=29), trauma-exposed healthy individuals (n=19) and healthy individuals without trauma exposure (n=18; Fertuck et al., 2016). In this study, participants rated the level of fearfulness of faces that were parametrically morphed along a fear dimension. However, in contrast to the studies summarized above, Fertuck et al., (2016) included participants that did not necessarily experience CM, but any traumatic event that is recognized as a Criterion A event. In addition, the sample size of the three groups was rather small, making it difficult to interpret null effects between groups. In another study, Shenk et al. (2013) even found a lower accuracy for the recognition of fear in maltreated adolescent females (n=50), as compared to nonmaltreated adolescent females (n=56). It is likely that variations in sample composition and study design might have contributed to these inconsistent findings.

Apart from the processing of facial expressions, decreased levels of interpersonal trust in individuals with a history of CM were consistently observed in cross-sectional studies using self-report measures (e.g., Blanchard-Dallaire & Hébert, 2014; Botsford et al., 2019; Pepin & Banyard, 2006; Vaile Wright et al., 2010). However, only a small number of experimental studies assessed behavioral (dis)trust in individuals who experienced CM. In a preceding study of our own working

group, we employed an economic game to assess behavioral distrust (Hepp et al., 2021). Economic games such as the trust game typically include an interaction partner and the choice to trust or not to trust the other player. This choice is associated with a monetary gain or loss, depending on whether the other player behaves in a trustworthy manner or not. We found higher levels of CM being associated with higher levels of distrust, as well as a weaker decrease in distrust following positive feedback (Hepp et al., 2021). Another study used a trust game and found no difference between girls with and without a history of physical or sexual abuse regarding their monetary contributions in the trust game (Sellnow et al., 2021).

In addition to the two outlined experimental studies that directly examined the association between CM and trust, there is also evidence from studies with PTSD samples. This evidence shows that individuals with PTSD made lower investments than healthy controls towards a cooperative partner in the trust game, but similar (low) investments when playing with an unfair game partner (Bell et al., 2019). However, interpersonal trust between individuals with PTSD (including non-interpersonal or adult-onset trauma) and those affected by CM (but not necessarily in combination with a PTSD diagnosis) may differ (Fertuck et al., 2016), thus requiring study designs that allow the dissociation of these effects (e.g., Pfaltz et al., 2022). Moreover, in addition to the trust game that was most frequently applied in those with a trauma history, other economic games such as the distrust game exist, which enable a more straightforward assessment of trustworthiness expectations (Hepp et al., 2021; Thielmann & Hilbig, 2014). Thus, while previous research suggests that CM entails increased levels of self-reported interpersonal distrust, more experimental research is needed to examine manifestations of distrust behavior. In addition, studies examining distrust as it occurs in real-life are needed to increase ecological validity.

In sum, theories and empirical evidence suggest that individuals with a history of CM show alterations in specific social-cognitive processes including hypersensitivity to interpersonal threats and increased distrust toward others. These processes possibly contribute to deficits in interpersonal functioning of individuals with a history of CM. However, the above reviewed

studies that investigate alterations in perceived threat and distrust in individuals with a history of CM are mostly of cross-sectional nature. It is thus unclear whether interpersonal threat sensitivity and distrust are relatively stable across situations or whether they fluctuate within the same person based on contextual factors. In the following section, I will discuss contextual factors that may affect the extent to which interpersonal threat sensitivity and distrust manifest in specific situations.

1.3 Assessing Relevant Contextual Factors

Alterations in specific social-cognitive processes, such as interpersonal threat sensitivity and distrust, might fluctuate not only between individuals but also within individuals. Whereas the majority of studies on social-cognitive processes in individuals with a history of CM focuses on the between-person perspective adopting a cross-sectional approach, fluctuations within the same person on a day-to day basis are rarely investigated (e.g., Hepp et al., 2021). It is, for example, possible that individuals with a history of CM show a hypersensitivity to interpersonal threats and high levels of distrust only in specific situations. This could be the case, for example, when being in a negative mood, when surrounded by strangers, when corresponding negative schemas were activated, or when encountering triggers of the traumatic events (e.g., Pfaltz et al., 2022; Pilkington et al., 2021; Weiss et al., 2021). Thus, gaining an in-depth understanding of contextual factors that potentially contribute to increased levels of perceived threat and distrust can have important implications for individuals affected by CM.

A unique way to measure within-individual processes are experience-sampling methods such as daily diaries or ambulatory assessment. Ambulatory assessment (AA) targets momentary experiences in real life, thereby reducing memory biases and increasing ecological validity (Solhan et al., 2009). Collected via smartphones or external devices, AA typically involves multiple assessments of the constructs of interest over time and additionally offers the possibility to assess potential internal and external influences on these processes (Trull & Ebner-Priemer,

2020). In the following paragraphs, I will summarize findings regarding emotional states as one potential contextual factor that might affect the manifestation of perceived interpersonal threat and distrust.

Previous work has demonstrated significant associations between affective states and normatively unrelated judgements (see Forgas & George, 2001; Isen & Baron, 1991, for reviews). According to the "feelings-as-information" theory, this is the case because people often misattribute their mood to the respective judgement, resulting in mood-congruent evaluations (Schwarz & Clore, 1988). Schwarz and Clore (1988) assume that when people make evaluative judgements, they implicitly ask themselves: "How do I feel about it?". Thus, an individual may infer from their own negative affect that another person is threatening or untrustworthy, potentially resulting in increased levels of distrust and interpersonal threat sensitivity when being in a negative affective state.

In line with the feelings-as-information approach, laboratory studies in healthy participants found an association between negative affect and evaluating others as less trustworthy (Dunn & Schweitzer, 2005), and between negative affect and reduced behavioral trust in the trust game (Mislin et al., 2015). Similarly, negative affect in healthy participants was associated with evaluating emotional faces in a negatively biased way (Bouhuys et al., 1995; Niedenthal et al., 2000; Schmid & Schmid Mast, 2010; Voelkle et al., 2014). However, laboratory studies typically induce affective states experimentally by using mood induction procedures that differ in type and effectiveness. In contrast, AA studies measure momentary affect as it naturally fluctuates in daily life, probably resulting in more complex and less intense emotional states. While the examination of emotional states (i.e., including dynamic mood processes such as mood changes and mood instability) has received a lot of attention in recent AA studies (e.g., Ebner-Priemer & Sawitzki, 2007; Santangelo et al., 2014; Trull, 2018; Wilhelm & Grossman, 2010), studies testing mood-congruent effects in daily life are rare (e.g., mood-congruent memory effects; Loeffler et al., 2013). Therefore, it is currently unclear whether the laboratory findings regarding interpersonal

threat sensitivity and distrust, as described above, can be reproduced when assessing momentary affect as it occurs in daily life. Moreover, it has not yet been tested whether individuals with a history of CM, who are known to frequently experience increased levels of negative affect (Bradley et al., 2011), are especially affected by threat hypersensitivity and distrust, as it manifests in different everyday life situations.

Taken together, interpersonal threat sensitivity and distrust possibly vary not only between individuals but also within individuals, depending for instance on the current affect. At this point, studies assessing within-person fluctuations of specific social-cognitive processes in real life are needed. AA allows the reliable assessment of such associations in the daily lives of the participants, thereby overcoming typical limitations that are associated with retrospective self-report measures or mood induction procedures in laboratory studies. Moreover, AA allows including between-person processes such as CM severity and an estimation of real-life effect-sizes.

1.4 Research Gaps and Aims

Research Gaps

In this introduction, I have summarized the devastating consequences of CM on physical and mental health, including a deficient interpersonal functioning and an increased risk for the development of mental disorders. I subsequently reviewed studies on potential mechanisms underlying these adverse outcomes, especially emphasizing alterations in social-cognitive processes that may have been affected by traumatic early life experiences, such as negative assumptions regarding safety and trust. Studies on potential social-cognitive mechanisms are still rare, especially AA designs were hardly used to examine these processes directly in the daily lives of individuals with a history of CM. However, AA studies would add to laboratory research in many ways, especially the possibility to assess within-person associations over a certain time period in conjunction with the assessment of relevant contextual factors seems promising.

Regarding the studies on interpersonal threat sensitivity and distrust in individuals with a history of CM, results overall suggest alterations in these social-cognitive processes (e.g., Catalana et al., 2020; Hepp et al., 2021; Pfaltz et al., 2022; Seitz et al., 2021). However, inconsistent results exist (Bell et al., 2019; Fertuck et al., 2016; Sellnow et al., 2021), possibly due to considerable variations in sample characteristics and study designs. Relating to the sample composition, most previous studies are limited by the fact that they only focused on one subtype of CM (mostly sexual abuse) instead of assessing all types of CM. Moreover, previous studies typically compared individuals with high levels of CM to individuals without a history of CM (i.e., case-control design). In our recent web-based study (Hepp et al., 2021), we therefore included individuals with varying levels of CM to be able to assess the effects of the intensity of CM on interpersonal threat sensitivity and distrust. Given the high prevalence of lower intensities and the continuous distribution of CM in the general population, it would be helpful to pursue this dimensional approach in terms of a continuous assessment of CM also in future studies (Carr et al., 2020; Sethi et al., 2013; Witt et al., 2019). Overall, only few studies examine interpersonal threat hypersensitivity and distrust in individuals affected by CM. Such studies suggest that these processes are of importance also for those who do not meet the criteria for a PTSD diagnosis. However, there is high variation in terms of study designs, with most of the previous studies conducted in the laboratory. Whereas laboratory studies enable research under controlled conditions, studies that are conducted in daily life offer other advantages, which I summarized above (e.g., high ecological validity, minimization of memory biases, multiple assessments over time, and assessment of within-person fluctuations / contextual factors).

Research Aims

Based on the research gaps I described above, and the previous findings of our own working group, I derived the *first aim* of this thesis, in which I tested the effects of momentary affective states on emotion processing and distrust in daily life (Chapter II). In this first study, I

applied novel paradigms measuring emotion processing and behavioral distrust for the first time by adopting an AA approach. Based on the results of previous laboratory studies that an individual's current mood may affect trustworthiness evaluations (Dunn & Schweitzer, 2005) and evaluations of emotional faces (Bouhuys et al., 1995; Niedenthal et al., 2000; Schmid & Schmid Mast, 2010; Voelkle et al., 2014), I assessed the current mood of the participants and hypothesized that being in a negative mood would entail increased levels of distrust and negatively biased ratings of emotional faces. To address this question, a sample of 42 healthy participants completed a 7-day AA study. Six times a day, they provided self-reports on their momentary mood and completed an emotion rating task and a hypothetical distrust game.

With the *second research aim*, I tested whether CM is associated with distrust and emotion processing in daily life (Chapter III). This is suggested by cognitive models of PTSD (Janoff-Bulman, 1989; McCann & Pearlman, 1990; McCann et al., 1988; Resick & Schnicke, 1993) and previous laboratory studies (Blanchard-Dallaire & Hébert, 2014; Botsford et al., 2019; Catalana et al., 2020; Hepp et al., 2021; Pepin & Banyard, 2006; Pfaltz et al., 2019; Seitz et al., 2021; Vaile Wright et al., 2010). Based on Study 1, I further hypothesized that momentary negative affect provides a context that strengthens this association. To this end, I conducted a second AA study, recruiting 61 individuals with varying levels of CM. Participants entered data on their momentary mood and completed an emotion rating task and a distrust game, which were established in Study 1, six times a day for seven days.

Study I: The effect of momentary mood on appraisal of facial affect and distrust: An experimental approach using ambulatory assessment

CHAPTER II

An adapted version of this chapter has been published as 'Schmitz, S. E., Hepp, J., Lane, S. P., & Niedtfeld, I. (2021). The effect of momentary mood on appraisal of facial affect and distrust: An experimental approach using ambulatory assessment. *Cognition and Emotion*, *35*(7), 1423-1430. doi: 10.1080/02699931.2021.1952933'

3.1 Abstract

Previous laboratory studies have demonstrated that an observer's current mood can influence their processing of facial stimuli, for instance the appraisal of facial affect. The aim of the present study was to explore the association between current mood and face processing in the participants' daily lives, thereby making use of naturally occurring affective states. We employed ambulatory assessment (AA) and included two experimental tasks to test whether current mood predicts how participants evaluate (i) the valence of emotional faces and (ii) facial trustworthiness. We hypothesized a mood-congruent processing, such that individuals would rate pictures of faces more negatively and less trustworthy, the more negative their current mood was. We recruited 42 participants who completed a 7-day AA study with six random prompts per day. At each prompt, participants provided self-reports on momentary mood and completed an emotion rating task and a hypothetical distrust game. Results show that negative momentary mood was significantly associated with higher levels of distrust, but was not significantly associated with more negative emotion ratings. We discuss the incremental value and feasibility of implementing experimental tasks in AA contexts and the opportunities this opens for assessing affective and cognitive processes in natural environments.

3.2 Introduction

The term *mood congruency* describes the phenomenon that the level of congruency between an individual's current mood and other affectively laden material influences their processing of this material. This applies to several cognitive processes, including, for instance, social judgements (Bodenhausen et al., 2001). More specifically, affective states are theorized to serve as a source of information when making evaluative judgements (Schwarz, 2012). According to this affect-as-information perspective, people interpret their current affect as a reaction to the judged object, resulting in mood-congruent evaluations. Accordingly, laboratory studies have demonstrated that positive mood resulted in more favorable first impressions (e.g., Forgas, 2011), including higher trustworthiness (Dunn & Schweitzer, 2005; Mislin et al., 2015). Moreover, people tend to interpret facial expressions in accordance with their current mood (Schiffenbauer, 1974; Schmid & Schmid Mast, 2010).

To date, mood-congruent processing of faces has primarily been investigated under controlled laboratory conditions. Some of these studies assessed affective states cross-sectionally, assessing affect at a single time-point, and therefore cannot test within-person effects. Others have experimentally induced affective states using within-subjects designs, but mood induction procedures varied considerably in type and effectiveness, which likely contributed to inconsistencies between studies. Importantly, it is unclear how effects of experimentally induced mood generalize to daily life affect, which might be less intense and more complex. Only little empirical work has examined mood-congruent effects in daily life, using ambulatory assessment (AA). Loeffler et al. (2013) were able to identify mood-congruent memory (MCM) effects, when taking into account subjective appraisals and physiological arousal. To the best of our knowledge, there are no AA studies that specifically investigate mood-congruent processing of facial stimuli, and the inclusion of experimental tasks within AA is especially rare. Therefore, we aimed to test the generalizability of mood-congruent effects in natural settings. Beyond an estimation of real-life effect-sizes, AA allows for a detailed investigation of setting- and context-specific

relationships. This is relevant to understand the circumstances under which mood-congruent effects might occur, intensify, or attenuate. Finally, the implementation of experimental tasks in AA is an important development in this field of research. To address the current research gap, we studied mood-congruent processing of faces under daily life conditions by implementing experimental tasks in AA. AA is well suited to examine fluctuating variables, such as naturally occurring affective states (Trull & Ebner-Priemer, 2013).

The Present Study

Previous laboratory research suggests that mood-congruent processing of faces is influenced by the observer's current affective state. We aimed to test whether momentary affective states affect the processing of facial affect and trustworthiness in daily life using a new experimental approach. Thus, beyond examining mood-congruent effects in daily life, we also aimed to introduce a new assessment method for the use in AA that was adapted from laboratory research (McEvily et al., 2012; Schmid & Schmid Mast, 2010; Thielmann & Hilbig, 2014).

Following mood-congruency models, we hypothesized that (1) momentary mood would be positively associated with the evaluation of facial affect. Specifically, the more positive an individual's current mood rating, the more positive they should appraise facial affect, and vice versa. Furthermore, we hypothesized (2) a negative association between momentary mood and interpersonal distrust. Specifically, we predicted that positive current mood would relate to lower distrust toward others.

3.3 Method

Participants

This study was part of a larger project (https://osf.io/zfsd9/?view_only=e68863dc88424ebb95fc6dbbaf712c5e). We recruited 44 healthy women between the age of 18 and 65 through an existing participant database (www.kfo256.de) at the Central Institute for Mental

Health in Mannheim, Germany.[1] A power-analysis showed that this sample size is sufficient to detect small sized within-person effects (see Appendix Chapter I). One participant answered questionnaires but did not participate in the AA study. Another participant answered only four prompts and was therefore excluded. The final dataset included 42 women, aged 21 to 50 (M = 29.88, SD = 7.50). The majority of the participants were single (73.81%), had an university entrance level degree (88.09%), and were currently studying or had an undergraduate degree (64.28%). For further demographic details, see Table A1 in the Appendix Chapter I.

Procedure

All methods and procedures were approved by the ethics committee of the medical faculty Mannheim at Heidelberg University (protocol no. 2018-588N-MA), and participants provided written informed consent prior to participation. During an orientation session, participants completed diagnostic interviews, provided demographic data, and filled in questionnaires not pertinent to the current investigation. They received an Android smartphone (Moto E, 2. Generation) and were instructed how to use the device. Participants selected an AA study period of seven running days, depending on their availability. Participants received a compensation of 70€, and a bonus of 30€ if they answered more than 90% of prompts.

During the study period, participants received six pseudo-randomized prompts per day via the movisensXS app (Movisens GmbH, Karlsruhe, Germany). The app spaced prompts evenly across the day by dividing the timeframe (8 a.m. to 10 p.m.) into six equal intervals. Within these intervals, random prompts occurred with a minimum of one hour between two prompts. Participants could delay responding up to three times (5, 10, or 15 minutes). Moreover, they could pause during completion of a questionnaire for up to five minutes. At each prompt, participants answered a short questionnaire about current mood, and then completed two experimental tasks to assess facial emotion processing and distrust (see Figure 1). Furthermore, they answered

[1] All participants underwent a careful diagnostic process to determine their mental health (see Appendix Chapter I).

questions on dissociation, intrusions, and interpersonal problems that were not relevant to the current investigation. Compliance was excellent, with participants completing, on average, 93.88% of random prompts, with an average of 39.42 (*SD* = 3.35) completed prompts per person. The total number of prompts across all participants was 1,764 prompts over 294 person days.

Ambulatory Assessment

Current mood: Current mood was assessed using an adapted version of the Multidimensional Mood Questionnaire (Wilhelm & Schoebi, 2007). Designed for the usage in AA studies, this scale shows an excellent between-person reliability and acceptable reliability of change for days (Wilhelm & Schoebi, 2007). At each prompt, participants rated how they felt "at this moment" by means of six bipolar items that assess *valence* (unwell-well, content-discontent), *calmness* (relaxed-tense, agitated-calm), and *energetic arousal* (tired-awake, full of energy-without energy). Each item was rated on a seven-point Likert-type scale (0-6). Since we did not assume any effects of energetic arousal on performance in the paradigms, we decided a-priori to only use a composite mood score including valence and calmness subscales, as indicated by Wilhelm and Schoebi (2007). For each prompt, we calculated a mean score of current mood including the four items unwell-well, content-discontent, relaxed-tense, and agitated-calm after recoding negatively poled items. Next, we created a mean of all momentary mood scores of each person, within-day (day-level mood indicator), and a mean score across all days, within-person (person-level mood indicator).

Emotion Rating Task: At each prompt, participants rated the emotional valence of 20 randomly sampled pictures of emotional faces (see Figure 1). Stimuli were created from the dynamic FACES, a database of morphed videos of male and female Caucasian adults that display naturalistic emotional facial expressions (Holland et al., 2019). The original FACES videos showed a neutral expression gradually transitioning into a fully developed emotion (happiness, fear, anger, disgust, sadness). Each video was fragmented into ten pictures with different

emotional intensities (ranging from 0 = neutral expression to 9 = full emotional expression). We randomly selected four happy pictures with different intensities, and four pictures displaying negative emotions in different intensities (one picture per emotion), for each identity. Across identities, we counterbalanced emotional intensities. The final set of stimuli consisted of 304 pictures with positive emotions and 304 pictures with negative emotions (76 target individuals). At each prompt, participants saw ten positive and ten negative emotional expressions, which were randomly selected. For each picture, participants evaluated the emotional expression on a bipolar scale, ranging from 0 (very negative emotion) to 6 (very positive emotion), and 3 being neutral.

Distrust Game: At each random prompt, participants played 20 rounds of a hypothetical distrust game (McEvily et al., 2012; Thielmann & Hilbig, 2014). The distrust game is an economic game with two players, a trustor and a trustee, who each receive the same initial amount of money. The trustee can then take away any amount of the trustor's money to increase his/her own payoff. For our purposes, we used a hypothetical version and instructed participants to imagine the target person on the screen as the trustee, and that they both receive 50€ at the beginning of each round (see Figure 1). For each round, participants then rated how much they thought the displayed person would take away from their money (from 0 to 50€ in 5€ steps). Higher scores in the distrust game (i.e., more money expected to be taken away) thus indicate higher levels of distrust. For each prompt, we randomly selected 20 stimuli from a larger stimulus set of 300 faces created by Oosterhof and Todorov (2008). We included stimuli of low (-3 SD), high (+3 SD), and medium level trustworthiness (0 SD).

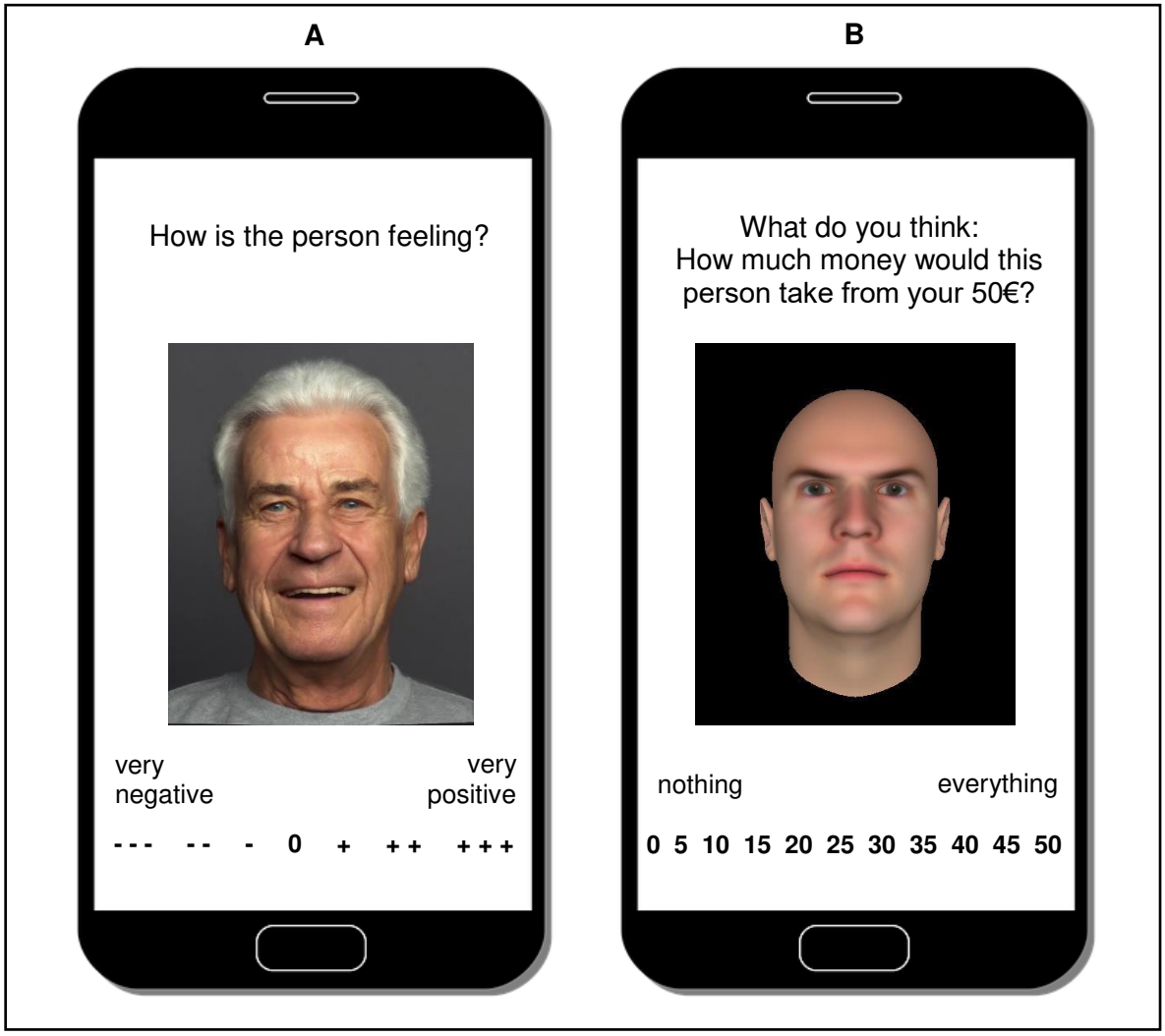

Figure 1. Exemplary illustration of the two experimental tasks. A: Emotion rating task, B: Distrust game.

Data Analysis

Multi-level models (MLMs) were conducted in R, Version 3.5.2, using the *lmer* function from the package *lme4* (Bates et al., 2014). The *lmerTest* package (Kuznetsova et al., 2017) was used to compute *p*-values and the *sjstats* package (Lüdecke, 2022) to compute effect sizes. We conducted two MLMs to assess the effect of current mood on the emotion rating task (positive and negative stimuli) and one MLM to assess the effect of current mood on the distrust game. In each MLM, we modelled random intercepts for each person, random slopes for momentary affect and day affect, and adjusted for the effects of the covariates weekday (from Sunday = 1 to Saturday = 7), study day (1-7), and time of day (in minutes; with 8 a.m. being coded as 0). We

centered momentary mood on the participant's day mean, daily mood on the person mean, and person-level mood on the grand mean to disaggregate mood variability across levels of analysis (Curran & Bauer, 2011).

To test hypothesis 1, that current mood positively predicts facial emotion ratings, we conducted one MLM using emotion ratings of the positive stimuli, and one MLM using emotion ratings of the negative stimuli as the criterion. We entered the following predictors in both models: momentary mood, day-level mood, person-level mood, and stimulus intensity (0 = neutral expression to 9 = full emotional expression), which was centered on the grand mean. To test hypothesis 2, that current mood negatively predicts distrust ratings, we conducted a MLM using distrust ratings (i.e., how much money participants thought target persons would take from them) as the outcome. As above, we included main effects for the predictors momentary mood, day-level mood, person-level mood, and stimulus intensity (0=low, 1=medium, 2=high trustworthiness), centered on the average stimulus intensity. Model equations are provided in the Appendix Chapter I.

3.4 Results

The dataset and analysis code are available in the OSF repository, https://osf.io/zfsd9/?view_only=e68863dc88424ebb95fc6dbbaf712c5e.

Descriptive Analyses

Participants endorsed rather positive mood ratings on average (M = 4.53, bSD = 0.81, wSD = 0.78). Accordingly, the distribution of the mood variable at the momentary level was skewed to the left (-0.62). In the emotion rating task, the average participant rating was M = 3.86 (bSD = 0.21, wSD = 1.25) for the positive stimuli and M = 1.93 (bSD =1.01, wSD = 0.27) for the negative stimuli on a scale ranging from 0 to 6. In the distrust game, participants indicated in 28.06 % of cases that the target person on the screen would take away 0€. On average, participants assumed that the target person in the distrust game would take 17.67€ (bSD = 8.33, wSD =12.54). The

average duration of the emotion rating task was *M* = 66.03 seconds (*SD* = 14.95), and the average duration of the distrust game was *M* = 61.78 seconds (*SD* = 21.17). For further descriptives, see Table A2 and Table A3 in the Appendix Chapter I.

Reliability analyses (following Shrout & Lane, 2012; for further details see Appendix Chapter I) revealed that the four mood items reliably assessed within-person change over time (R_C = 0.80). With R_{KR} = 0.97, between-person reliability of average mood levels across time points was also excellent. For the ratings of perceived emotion in the emotion rating task, between-person reliability was R_{KR} = 1.00 for the model entering positive stimuli, and R_{KR} = 0.98 for the model entering negative stimuli. Reliability of change for the positive stimuli was R_C = 0.76, and R_C = 0.32 for the negative stimuli. Distrust ratings showed an excellent between-person reliability (R_{KR} = 0.99), while reliability of change was moderate (R_C = 0.64).

We also computed intraclass correlation coefficients (ICCs) to estimate the proportion of variance at the momentary, day and person level in each of the two tasks. The largest proportion of variance was at the momentary level in both the emotion rating task (positive stimuli: ICC_{mom} = 0.97, ICC_{day} < 0.01, ICC_{pers} = 0.03; negative stimuli: ICC_{mom} = 0.92, ICC_{day} = 0.01, ICC_{pers} = 0.06) and the distrust game (ICC_{mom} = 0.67, ICC_{day} = 0.05, ICC_{pers} = 0.28). For the mood variable, the largest proportion of variance was at the person level, closely followed by momentary and day level (ICC_{mom} = 0.33, ICC_{day} = 0.20, ICC_{pers} = 0.47).

Momentary Mood Predicting Distrust and Emotion Ratings

Main results are presented in Table 1. With regard to hypothesis 1, momentary mood was not significantly associated with the emotion ratings of the positive (model 1a) or negative stimuli (model 1b). However, the intensity of the stimulus was significantly associated with the ratings in both models (positive and negative stimuli): more intense stimuli were rated as more intense by the participants. Results further showed a significant positive association between weekday/study day and momentary ratings of positive stimuli. This indicated that, as the week

goes on and in the course of the assessment period, positive stimuli were rated more positively. In the model predicting momentary ratings of negative stimuli results showed a significant effect of weekday (negative) and study day (positive). Thus, as the week goes on, negative stimuli were rated more negatively, whereas ratings became more positive toward the end of a participants' assessment period. Following suggestions by an anonymous reviewer, we conducted an additional analysis using all stimuli, including a dummy variable that coded whether a negative or a positive stimulus was presented. These results can be found in the Appendix Chapter I.

With regard to hypothesis 2, results further revealed that momentary mood showed a significant negative association with momentary distrust ratings, indicating that participants experienced more distrust in moments of negative mood, and less distrust in moments of positive mood. Additionally, trustworthiness of the stimulus material was negatively associated with distrust ratings, validating that trustworthy targets elicited less distrust. We further found a significant positive association between time of day and momentary distrust ratings, and between study day and momentary distrust ratings, suggesting that toward the end of a day and toward the end of their assessment period, participants indicated more distrust.

Table 1

Results from three linear mixed effects models predicting the emotion ratings (positive and negative stimuli separately) and the distrust ratings with momentary, day-level and person-level average mood, intensity of the stimulus material, weekday, time of day and study day

Outcome and predictor	*Est.*	*SE*	*p*	*ß*	*CI low*	*CI high*
Model 1a: Emotion ratings (positive stimuli)						
Momentary mood	-0.00	0.01	.957	-0.00	-0.01	0.01
Day mood	0.02	0.02	.352	0.01	-0.01	0.02
Person mood	-0.00	0.04	.924	0.00	-0.05	0.05
Intensity	0.36	0.00	<.001	0.81	0.80	0.81
Weekday	0.01	0.00	.001	0.02	0.01	0.02
Time of day	-0.00	0.00	.117	-0.01	-0.02	0.00
Study day	0.01	0.00	.028	0.01	0.00	0.02
Model 1b: Emotion ratings (negative stimuli)						
Momentary mood	0.02	0.01	.072	0.01	0.00	0.02
Day mood	0.00	0.03	.951	0.00	-0.02	0.02
Person mood	-0.03	0.05	.535	-0.02	-0.10	0.05
Intensity	-0.24	0.00	<.001	-0.64	-0.65	-0.63
Weekday	-0.01	0.00	.001	-0.02	-0.03	-0.01
Time of day	-0.00	0.00	.293	-0.01	-0.02	0.01
Study day	0.02	0.00	<.001	0.03	0.02	0.04
Model 2: Distrust ratings						
Momentary mood	-0.23	0.10	.034	-0.01	-0.02	0.00
Day mood	15.40	15.13	.315	0.47	-0.44	1.38
Person mood	1.00	1.63	.543	0.06	-0.11	0.22
Trustworthiness	-9.41	0.07	<.001	-0.49	-0.50	-0.48
Weekday	-0.00	0.03	.984	-0.00	-0.01	0.01
Time of day	0.00	0.00	<.001	0.02	0.02	0.03
Study day	0.45	0.03	<.001	0.06	0.05	0.07

Note. Est. = Estimate.

3.5 Discussion

We examined the relationship between momentary mood and the processing of facial stimuli by using two experimental tasks that we newly implemented for the use in AA. As hypothesized, momentary mood was significantly negatively associated with momentary distrust ratings, suggesting that the more negative a participant's current mood was, the more distrust they experienced at that moment. This replicated and extended findings on mood-congruent processing of facial trustworthiness from previous laboratory studies (Dunn & Schweitzer, 2005; Mislin et al., 2015). Extending between-person evidence, we demonstrated that negative affect increased interpersonal distrust at a momentary, within-person level. Although the effect size of this association is rather small, it has to be taken into account that the underlying data reflect the daily life context of several events (unlike effects reported in most laboratory studies). Therefore, the reported small effect could still represent a meaningful finding.

In addition to three-level models with momentary, day, and person levels, we, on the recommendation of an anonymous reviewer, also conducted two-level models in which we did not include a day level (see additional analyses in the Appendix Chapter I). As can be seen in Table A5 (Appendix Chapter I), the significant effect of momentary mood on the distrust ratings was not observed in the two-level model. However, not including the day level significantly worsened the fit of our model (X^2 [2, N = 42] = 700.38, p <.001; AIC_{3lev} = 251015 vs. AIC_{2lev} = 251712; BIC_{3lev} = 251116 vs. BIC_{2lev} = 251796), which is why we a priori considered day-level processes/experiences as an important unit of analysis that momentary processes should be compared against.

In contrast to distrust ratings, momentary emotion ratings were not significantly associated with momentary mood. This is not in line with previous results from laboratory studies demonstrating an effect of mood on the evaluation of facial expressions (Schiffenbauer, 1974; Schmid & Schmid Mast, 2010). However, some laboratory studies could not replicate mood-congruent effects on the evaluation of facial affect. In this context, it was discussed whether

positive and negative stimuli are processed differently (e.g., Baumeister et al., 2001). Apart from effects of the stimulus material, previous studies have found that momentary positive and negative affect have a differential effect on the evaluation of facial affect (e.g., Coupland et al., 2004). If mood-congruent effects are larger for negative mood, we were probably not able to detect it based on our current sample, endorsing rather positive mood. We, therefore, suggest a separate assessment of positive and negative affect in future AA studies to test mood-congruent effects in more detail.

Our results suggest that the two experimental tasks were successfully implemented in AA. First, intraclass correlation coefficients for both paradigms revealed that the largest proportion of variance was at the momentary level, indicating that emotion processing and distrust vary throughout the day. We, therefore, recommend repeated assessments of these processes in daily life in future studies. Second, we found that stimulus intensity was significantly associated with the respective participant ratings, demonstrating that the experimental within-person manipulation was successful in both tasks. Finally, the feasibility of experimental tasks in AA was confirmed by a relatively short prompt duration in this study and excellent compliance.

The study has several limitations. First, the sample consisted of a relatively homogenous group of healthy women who reported being in a positive mood most of the time. This contributed to a left-skewed distribution of our mood predictor that may have attenuated the investigated associations. Although the use of an exclusively female sample limits generalization to mixed gender populations, it reduced heterogeneity, which might be useful given that there is some evidence on sex differences regarding mood (Fujita et al., 1991). It is important to replicate the present findings using a more heterogeneous (e.g., mixed gender, clinical/ subclinical) sample to achieve a better distribution of mood scores and increase generalizability. Second, reliability analyses of the newly implemented experimental tasks revealed relatively low within-person reliability of the emotion rating task (esp. of negative stimuli). This might have also contributed to the differential pattern of results for the emotion rating task, as compared to the distrust game.

Finally, when modelling two levels (momentary and person level) instead of three levels (momentary, day and person level), we could not reproduce the same pattern of results. Therefore, the significant effect of momentary mood on distrust ratings must be interpreted cautiously. However, when directly comparing the model fit using multilevel model fit statistics, we found that the three-level structure improved model fit significantly.

To summarize, in our study we newly implemented two experimental tasks for the use in AA, and identified momentary mood as a predictor for interpersonal distrust. However, momentary mood did not predict the evaluation of emotional faces in the current study, which might be due to sample characteristics and the restricted variance of the mood predictor. Thus, our results were only partly consistent with mood-congruency models, and further studies are needed to investigate the association between momentary mood and emotion processing in samples that are more heterogeneous. To conclude, we established that the implemented experimental measures are feasible in AA, and that mood-congruent effects replicate in daily life.

Study II: Negative affect provides a context for increased distrust in the daily lives of individuals with a history of childhood maltreatment

CHAPTER III

An adapted version of this chapter has been published as 'Schmitz, S. E., Niedtfeld, I., Lane, S. P., Seitz, K. I., & Hepp, J. (2023). Negative affect provides a context for increased distrust in the daily lives of individuals with a history of childhood maltreatment. *Journal of Traumatic Stress*, *00*, 1-12. doi: 10.1002/jts.22951'

4.1 Abstract

Evidence on individuals affected by Posttraumatic Stress Disorder (PTSD) following childhood maltreatment (CM) supports cognitive models suggesting that trauma engenders distrust and interpersonal threat sensitivity. We examined the associations between CM and both distrust and interpersonal threat sensitivity in daily life and investigated whether momentary negative affect provides a context that strengthens these associations. Hypotheses were based on cognitive models of trauma and the feelings-as-information theory. In a 7-day ambulatory assessment (AA) study with six semirandom daily prompts (2,295 total), we measured self-reported momentary negative affect and assessed behavioral trust as well as interpersonal threat sensitivity via facial emotion ratings with two novel experimental paradigms in 61 participants with varying levels of CM (45,900 total trials). As hypothesized, negative affect was associated with increased momentary distrust, $\beta = .03$, $p = .002$, and interpersonal threat sensitivity, $\beta = -.01$, $p = .021$. Higher levels of CM were associated with more negative emotion ratings, independent of affective context, $\beta = -.07$, $p = .003$. Momentary behavioral distrust was associated with CM at high levels of momentary negative affect, $\beta = .02$, $p = .027$. The findings for both tasks support the feelings-as-information theory and suggest that cognitive alterations surrounding distrust and interpersonal threat, which were originally proposed for PTSD, likely also affect individuals with a history of CM.

4.2 Introduction

Childhood maltreatment (CM), defined by the World Health Organization (WHO) as "the physical, sexual, mental abuse and/or neglect of children younger than 18 years" (p. 8; Sethi et al., 2018), is highly prevalent in the general population (i.e., 40%–50%; Stoltenborgh et al., 2014). CM can have detrimental long-term effects on physical and mental health (Leeb et al., 2008), including an increased risk of developing Posttraumatic Stress Disorder (PTSD; e.g., Kessler et al., 2017; Perrin et al., 2014). The cognitive model of PTSD posits that experiencing trauma, such as CM, engenders negative cognitions about the world, other people, and one's self (Nelson et al., 2002; Resick & Schnicke, 1993). Among others, these cognitions include distrust (e.g., "I cannot trust anyone") and perceived threat from others (e.g., "Others could harm me"), both of which can substantially impair relationships and social functioning (Nelson et al., 2002; Resick & Schnicke, 1993).

Previous studies in CM samples have demonstrated that CM is associated with increased distrust and interpersonal threat sensitivity. One common way to measure interpersonal threat sensitivity in psychopathology research is to assess participants' reactions to pictures of faces showing negative expressions. Researchers have used a variety of tasks for this purpose, including visual attention tasks (e.g., Seitz et al., 2021) and emotion rating tasks (e.g., Bell et al., 2017), all of which use pictures of emotional faces as potentially threat-inducing stimuli. These images include faces showing fear and sadness (e.g., Bell et al., 2017; Bertsch et al., 2017; Cowden Hindash et al., 2019; Fonzo et al., 2010; Seitz et al., 2021), which can signal potential threat in the environment, thus invoking fear in the participant or signaling that something threatening has invoked sadness. Some researchers have also used images of faces displaying expressions of anger or disgust (e.g., Bell et al., 2017; Bertsch et al., 2017; Chu et al., 2016; Cowden Hindash et al., 2019; Fonzo et al., 2010; Seitz et al., 2021), signaling that the displayed person itself may be a threat to the observer. In addition to negative emotional expressions, all of these studies have also included either neutral or positive (i.e., happy or joyful) expressions as a comparison condition.

With regard to CM evidence, previous studies have shown associations between CM and the overattribution of anger, contempt, and fear to neutral faces (Catalana et al., 2020; Pfaltz et al., 2019); the misclassification of emotional and neutral faces as angry (Seitz et al., 2021); and negative evaluations of angry and fearful faces (Hepp et al., 2021). Individuals who have experienced trauma have also been found to prefer a larger interpersonal distance between themselves and others (Lüönd et al., 2022; Maier et al., 2020), which may also be related to interpersonal threat sensitivity, as intrusions into one's personal space can induce a sense of discomfort and feelings of interpersonal threat (Hayduk, 1983).

Regarding distrust, two studies have demonstrated a negative association between CM and self-reported interpersonal trust (Pepin & Banyard, 2006; Vaile Wright et al., 2010), and another recent study found an association between CM and behavioral distrust in an economic game (Hepp et al., 2021). Behavioral measures of trust originally stem from the field of behavioral economics (Thielmann et al., 2021) and are an important addition to other—primarily attitudinal—measures of trust. Different types of trust games exist. These games typically employ a forced-choice format to infer a preference for one of two options (e.g., trust the other player or do not trust her/ him); these options are associated with monetary gains or losses depending on whether the other player behaves in a trustworthy manner or not. Compared to similar trust-related games previously used in samples of individuals with a trauma history (Lenow et al., 2015; Sellnow et al., 2021), the distrust game enables a more straightforward assessment of the expected trustworthiness of the interaction partner (Thielmann & Hilbig, 2014). Thus, previous work suggests that CM entails increased distrust toward others and a more negative appraisal of emotional expressions, potentially due to higher sensitivity toward possible signs of interpersonal threat, as suggested by cognitive models of PTSD (Ehlers & Clark, 2000; Resick & Schnicke, 1993).

What remains unclear is how prevalent distrust and interpersonal threat sensitivity are in the daily lives of people with varying levels of CM. It is highly probable that both are context-dependent (see Weiss et al., 2021). One context in which increased levels of distrust and

interpersonal threat sensitivity may occur is a state of negative affect. This is suggested by the feelings-as-information theory, which proposes that affective states serve as a source of information when making evaluative judgments (Schwarz & Clore, 1983). In line with this, laboratory studies in healthy participants have shown associations between negative affect and the evaluation of others as less trustworthy (Dunn & Schweitzer, 2005), reduced trust behavior in a trust game (Mislin et al., 2015), and negatively biased processing of facial emotional expressions (Schmid & Schmid Mast, 2010). Additionally, the findings from a recent daily life study suggest that behavioral distrust is increased in moments of heightened negative affect among individuals without mental health problems (Schmitz et al., 2021). If individuals with more severe CM showed higher interpersonal threat sensitivity and higher levels of behavioral distrust in daily life, and if momentary negative affect further strengthened this association as a relevant context variable, these associations could be addressed therapeutically to improve interpersonal functioning, which is often impaired in individuals with a history of CM (Pfaltz et al., 2022).

Consequently, the present study used ambulatory assessment (AA; Trull & Ebner-Priemer, 2020) to investigate whether momentary negative affect provides a context for increased distrust and interpersonal threat sensitivity in the daily lives of individuals with a history of CM. We employed two experimental paradigms to measure behavioral distrust and interpersonal threat sensitivity, which were carefully established in a previous AA study with an independent sample of mentally healthy participants (Schmitz et al., 2021) and applied cross-sectionally to a large web-based sample of individuals with a CM history (Hepp et al., 2021). Thus, before applying the paradigms in this study, previous research had demonstrated both within-participant outcome variance and between-participant outcome variance, depending on the level of CM experienced.

We preregistered the study methods prior to data collection (https://osf.io/tw7mx). This included the recruited sample, the AA sampling scheme, the two paradigms, and self-report measures. In the preregistration document, we additionally specified multivariate, multilevel mediation analyses to test complex associations among negative affect, distrust, interpersonal

threat sensitivity, CM, and interpersonal events. The inclusion of the interpersonal events variables was beyond the scope of this manuscript; therefore, a future manuscript will describe results related to interpersonal events as well as the complex preregistered analyses. Herein, we tested individual paths of the multivariate model we preregistered, but not the full model; hence, we refrain from calling these tests, and the respective hypotheses, preregistered. All presented analyses are primary analyses of the data, and they have not been previously reported.

Hypotheses were based on the cognitive model of PTSD, which suggests that trauma engenders increased distrust and interpersonal threat sensitivity (Ehlers & Clark, 2000; Resick & Schnicke, 1993), as well as on previous empirical work showing that this extends to individuals with CM (Catalana et al., 2020; Hepp et al., 2021; Pepin & Banyard, 2006; Pfaltz et al., 2019; Vaile Wright et al., 2010). In addition, the hypotheses are rooted in the feelings-as-information theory (Schwarz & Clore, 1983), which has seen empirical support in previous work (Dunn & Schweitzer, 2005; Mislin et al., 2015; Schmid & Schmid Mast, 2010; Schmitz et al., 2021). First, we hypothesized that higher levels of CM would be associated with a more negative rating of facial expressions "in the moment," which we interpreted as a proxy for interpersonal threat sensitivity. In addition, we posited that higher momentary negative affect would be associated with a more negative rating of facial expressions in the moment. We also expected that momentary NA would strengthen the association between CM and ratings of facial expressions (i.e., negative affect as a momentary moderator). Second, we hypothesized that higher levels of CM would be associated with more momentary distrust. We additionally expected that higher momentary negative affect would be associated with higher ratings of momentary distrust and that momentary negative affect would strengthen the association between CM and momentary distrust (i.e., negative affect as a momentary moderator).

4.3 Method

Participants

We determined the sample size, data exclusions, manipulations, and study measures a priori (https://osf.io/tw7mx). We preregistered a sample size of 70 individuals with varying levels of CM. Due to lockdown measures resulting from the COVID-19 pandemic, data collection had to be interrupted and eventually terminated when only 62 participants had been recruited. Of note, increasing the sample size from 62 to 70 participants increased power by 0.1% for CM, 2.1% for the cross-level interaction, and 6.5% for momentary negative affect. Participants were recruited via different online (e.g., project homepage, social media) and offline sources (e.g., newspaper advertisements, local clinics) as part of a research consortium on the consequences of adverse childhood experiences (https://grk2350.de). We included individuals with varying levels of CM, as assessed using the Childhood Trauma Screener (CTS; Grabe et al., 2012), a short-form version of the Childhood Trauma Questionnaire (CTQ; Bernstein & Fink, 1998). If participants endorsed at least one of the five CTS items (i.e., one item per CM type), they were included in the study. Exclusion criteria were defined in accordance with other research consortium projects and included a lifetime diagnosis of Schizophrenia or Bipolar I Disorder, the use of psychotropic medication except for selective serotonin reuptake inhibitors and serotonin and norepinephrine reuptake inhibitors, inadequate German language proficiency, the acute threat of harming oneself or others, brain disease, severe internal or neurological diseases, current pregnancy, and the current use of illegal substances. Participants with a moderate or severe Substance Use Disorder (SUD) had to be in remission for twelve months or longer, and those with a mild SUD had to be in remission for two months or longer. One participant was excluded due to technical difficulties that resulted in AA data loss. The final dataset included 61 participants aged 19 to 59 years (M = 31.52 years, SD = 10.51), 88.5% of whom were women and 11.5% of whom were men. Most participants had a lifetime diagnosis of a mental disorder (75.4%), and 60.7% had previously

received outpatient treatment. See Table 2 for details on demographic data and Table 3 for detailed diagnoses.

Procedure

Study procedures were approved by the Ethics Committee of the Medical Faculty Mannheim at Heidelberg University (protocol no. 2018–588N-MA). All participants provided written informed consent before in-person participation. Eligibility was determined via a phone screening. If participants reported CM during the screening, they were invited for an in-person diagnostic session during which the exclusion criteria and mental health diagnoses were assessed. Diagnoses were based on criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013) and established by trained clinical psychologists using the German version of the Structured Clinical Interview for DSM-5 (SCID-5; Beesdo-Baum et al., 2019; First et al., 2016). Interrater reliability was established by randomly selecting twelve videotaped diagnostic interviews, which were rated by the head of the diagnostic unit and six independent raters. For the investigated diagnoses, there was complete agreement between the raters, Fleiss' $\kappa = 1.0$ (Fleiss et al., 2003). According to a review by Cicchetti (1994), this corresponds with an "excellent" interrater reliability. During the interview session, participants also provided demographic data, filled in self-report questionnaires, and completed a urine drug screening.

Next, participants were introduced to the study phone (Moto E, 2nd generation) running the movisensXS app (Version 1.4.8; Movisens GmbH, Karlsruhe, Germany). The AA protocol mirrored the protocol reported in Schmitz et al. (2021), except that we added several CM-specific self-report items to the random prompts. Over the 7-day study period, participants answered six pseudorandomized prompts per day. Prompts were spaced evenly across the day by dividing the daily study timeframe (i.e., 8 a.m.–10 p.m.) into six equal intervals. Within these intervals, prompts occurred randomly with at least 1 hr between two prompts. At each prompt, participants

answered questions on momentary affect, dissociative symptoms, and intrusions and completed two experimental tasks to assess distrust and interpersonal threat sensitivity (cf. Schmitz et al., 2021). Although we further assessed interpersonal events and trauma-specific affect (e.g., disgust with self), these findings will be addressed in a future manuscript.

AA compliance was high, with participants completing, on average, 90.5% of the random prompts. This resulted in an average of 37.62 (*SD* = 6.22) completed prompts per person and a total of 2,295 prompts with 45,900 trials for each paradigm over 421 person-days. Participants received a compensation of 70€ (EUR), with a 30€ bonus if they completed more than 90% of the prompts. Participants required an average of 3.87 min (232.44 sec) to answer a prompt. See Table B1 in the Appendix Chapter II for further AA details.

Table 2

Sample demographic characteristics

Variable	*n*	%
Nationality		
German	58	95.1
German-Italian	1	1.6
German-Chilean	1	1.6
Austrian	1	1.6
Housing situation		
Alone	18	29.5
With partner/own family	26	42.6
With parents	4	6.6
Shared apartment	12	19.7
No regular living conditions	1	1.6
Relationship status		
Single	40	65.6
Married	9	14.8
Long-term relationship	4	6.6
Divorced	7	11.5
Widowed	1	1.6
Formal education		
Graduation after 9 years	2	3.3
Graduation after 10 years	8	13.1
Graduation after 12–13 years	51	83.6
Current or past psychotherapy		
Inpatient/semi-inpatient treatment	24	39.3
Outpatient treatment	37	60.7
None	18	29.5
Current psychotropic medication		
SSRI	5	8.2
SNRI	4	6.6
Discontinued for participation	5	6.6
None	47	77.1
Past suicide attempts		
One	3	4.9
More than one	9	14.75
None	49	80.3

Note. $N = 61$. SSRI = selective serotonin reuptake inhibitor; SNRI = serotonin and norepinephrine reuptake inhibitor.

Table 3

Current and lifetime clinical diagnoses

Variable	Current		Lifetime	
	n	%	*n*	%
No lifetime diagnosis according to SCID-5-CV	–	–	15	24.6
Posttraumatic stress disorder	17	27.9	21	34.4
Major depressive disorder, single episode	1	1.6	8	13.1
Major depressive disorder, recurrent episode	11	18.0	28	44.3
Persistent depressive disorder	5	8.2	5	8.2
Brief psychotic disorder	0	0.0	1	1.6
Substance use disorder[a]	3	4.9	16	26.2
Panic disorder/agoraphobia	1	1.6	5	8.2
Social anxiety disorder	8	13.1	12	18.0
Generalized anxiety disorder	1	1.6	1	1.6
Specific phobia	3	4.9	3	4.9
Obsessive–compulsive disorder	1	1.6	2	3.3
Anorexia nervosa	0	0.0	6	9.8
Bulimia nervosa	1	1.6	6	9.8
Somatic symptom disorder	6	9.8	6	9.8
Other DSM-5 Disorder	2	1.6	5	8.2

Note. SCID-5–CV = Structured Clinical Interview for DSM-5 Disorders–Clinician Version; DSM-5 = Diagnostic and Statistical Manual of Mental Disorders (5th ed.).

[a]In the case of a mild substance use disorder, abstinence of at least two months was required; a moderate/severe substance use disorder required abstinence of at least twelve months.

Measures

CM: We used the German versions of the CTQ (Bader et al., 2009; Bernstein et al., 1998) to assess self-reported CM before age 18. The CTQ comprises five subscales with five items each and is used to assess the frequency of different types of CM (i.e., emotional neglect, emotional abuse, physical neglect, physical abuse, and sexual abuse). Each item is rated on a five-point Likert-type scale ranging from 1 *(not at all*) to 5 (*very often*). The total score is calculated as the

sum of all subscales and ranges from 25 to 125. In the current sample, the CTQ showed an excellent internal consistency, Cronbach's α = .95, 95% CI [.92, .96], Ω = .96.

Momentary negative affect: We assessed momentary negative affect using a short questionnaire designed for use in e-diary studies (Wilhelm & Schoebi, 2007). At each random prompt, participants rated how they felt "at this moment" by means of six items assessing *valence* (unwell–well, content–discontent), *calmness* (relaxed–tense, agitated–calm), and *energetic arousal* (tired–awake, full of energy–without energy). Items were rated on a 7-point Likert-type scale ranging from 0 to 6. Following Wilhelm and Schoebi (2007), we used the valence and calmness subscales to create a composite negative affect score. We computed a mean score for the following four items: unwell–well (reverse-scored), content–discontent, relaxed–tense, and agitated–calm (reverse-scored). We then created per-person daily score means and total person means for this variable.

Emotion rating task: For each prompt, participants completed 20 trials of a task first described in Schmitz et al. (2021). In each trial, they saw a stimulus face displaying either a positive (i.e., happy) or negative emotion (i.e., fear, anger, disgust, or sadness), and were asked to rate the valence of the displayed emotion on a 7-point Likert-type scale ranging from 0 (*very negative*) to 6 (*very positive*). Stimuli were created using the dynamic FACES stimulus database (Ebner et al., 2010). We fragmented each video into ten pictures to obtain different emotional intensities (i.e., 0 = the first frame in which no emotion was present, 9 = fully expressed emotion). From this stimulus pool, we randomly selected four happy pictures and one picture for each negative emotion (i.e., fear, anger, disgust, and sadness) for each identity. Emotional intensities were counterbalanced across identities. Thus, the final stimulus set comprised 304 positive and 304 negative expressions; however, the ratio of low-intensity to neutral expressions was high. At each prompt, ten positive and ten negative emotional expressions were randomly selected and presented. Reliability for individual differences in emotion ratings (i.e., person averages across all AA prompts, calculated as the mean Cronbach's alpha) was excellent, R_{KF} = .98; reliability for

individual random prompts was fair (i.e., momentary Cronbach's alpha across the 20 faces at a given prompt), R_{1R} = .71; and reliability for change (i.e., difference scores for face ratings from one prompt to the next) was poor, R_C = .25 (Shrout & Lane, 2012).

Distrust game: At each prompt, participants completed 20 trials of a modified distrust game previously described in Schmitz et al. (2021). In the distrust game, two players receive the same initial amount of money. The trustee is then able to take away any amount from the trustor's stash to increase their own payoff. The dependent variable is the trustor's estimate of how much money the trustee will take from them, with higher amounts indicating more distrust. In the present study, participants played a hypothetical version without real monetary stakes. In each trial, the participant was shown the face of a hypothetical trustee and instructed to imagine they were playing a distrust game with that person. In the role of the trustor, participants then indicated how much money they thought the depicted trustee would take away from their own stash, ranging from 0€ to 50€ in 5€ increments. Stimuli for the trustees were 300 computerized faces that varied regarding their level of trustworthiness (Oosterhof & Todorov, 2008). We selected 100 identities for each of three levels of trustworthiness based on the stimulus set's norm ratings, including low, medium, and high levels of trustworthiness. At each random prompt, 20 stimuli were randomly drawn and presented. Reliability for individual differences in distrust ratings was excellent, R_{KF} = .99; reliability for individual random prompts was good, R_{1R} = .82; and reliability for change was fair, R_C = .70 (Shrout & Lane, 2012).

Covariates: We preregistered dissociation and intrusions as covariates and assessed these constructs at each random prompt. Both dissociation and intrusions can substantially impact all levels of experience (i.e., cognitive, affective, and sensory), hence we wanted to ensure they did not confound the associations of interest and statistically adjusted for them. *Dissociative symptoms*: We assessed dissociative symptoms in the present moment using the Dissociation Tension Scale (DSS-4; Stiglmayr et al., 2009). The four DSS-4 items—one each for depersonalization, derealization, somatoform dissociation, and analgesia—are rated on a 10–point

Likert-type scale ranging from 0 (*not at all*) to 9 (*very strongly*). The four-item mean was used as a covariate in all analyses. *Intrusions*: We assessed intrusions using a single yes/no item: "Since the last prompt, I had involuntary memories of traumatic experiences in my childhood/youth." If a respondent endorsed experiencing intrusions, they were asked to rate their impact, vividness, "nowness," intrusiveness, avoidance, and emotionality on a scale ranging from 0 (*not at all*) to 6 (*very*), following Kleim et al. (2013). The dichotomous variable indicating whether intrusions occurred (1 = yes, 0 = no) was entered as a covariate. *Additional covariates*: Additional preregistered covariates were gender (female = 0, male = 1), day of the week (from Sunday = 1 to Saturday = 7), weekend (0 = weekday, 1 = weekend), time of day (in minutes; 8 a.m. = 0), and study day (1–7).

Data Analysis

All data and code necessary to reproduce these analyses are available at https://osf.io/zfsd9/. Analyses testing the study hypotheses were conducted in R. We used the *lmer* function from the *lme4* package to conduct multilevel models (MLMs) and the *lmerTest* package to obtain *p* values. We modeled random intercepts for each person and day and random slopes for momentary negative affect. Momentary negative affect was centered on the participant's day mean, daily negative affect was centered on the person mean, and person-level negative affect was centered on the grand mean. The total CTQ and stimulus valence scores were centered on the grand mean.

To test our first hypothesis (i.e., that CM, negative affect, and their interaction would predict emotion ratings), we conducted an MLM using emotion ratings as the criterion, predicted by the CTQ total score; momentary, day-level, and person-level negative affect; the CTQ x negative affect interaction to test moderation effects (Hayes, 2009); stimulus valence (−9 = fully negative expressed emotion to 9 = fully positive expressed emotion); and covariates. To test our second hypothesis (i.e., CM, negative affect, and their interaction would predict momentary

distrust), we conducted a second MLM using distrust ratings as the outcome. Predictors were the same as for the first hypothesis except that the trustworthiness of the stimulus (0 = low, 1 = medium, 2 = high trustworthiness) was included instead of stimulus valence.

4.4 Results

Total CTQ scores ranged from 27 to 117 in this sample (M = 58.84, SD = 21.97; see Table B2 for descriptives by subscale, and Table B3 for intercorrelations between subscales in the Appendix Chapter II). Participants indicated dissociative symptoms at 21.5% of prompts, although, on average, the levels were very low (DSS-4: M = 0.50, SD = 1.30).

The main results are presented in Table 4. As hypothesized, CM was a significant negative predictor of momentary emotion ratings, indicating that participants who experienced higher levels of CM tended to respond with more negative emotion ratings. Likewise, momentary negative affect was a significant negative predictor of emotion ratings, suggesting that participants evaluated faces more negatively when being in a state of negative affect. Contrary to our predictions, the CM x negative affect interaction was nonsignificant (see Figure 2). Thus, our prediction that negative affect would provide a context for the association between CM and emotion ratings did not obtain sufficient support. Significant covariates were the stimulus valence (i.e., more positive stimuli were rated more positively), time of day (i.e., more negative ratings later in the day), and study day (i.e., more positive ratings later in the study). We did not observe significant effects for the intrusions and dissociation covariates.

Table 4

Results of two multilevel models using distrust and emotion ratings as outcomes predicted by momentary negative affect, childhood maltreatment (CM)[a], and covariates

Outcome and predictor	*Estimate*	*β*	*SE*	*p*
Emotion ratings				
Intercept	2.72	-.04	.04	< .001
CM	-0.01	-.07	.00	.003
Momentary negative affect	-0.02	-.01	.01	.021
CM x Momentary negative affect	-0.00	-.01	.00	.214
Day negative affect	-0.01	-.004	.01	.368
Person negative affect	-0.04	-.02	.04	.267
Stimulus valence	0.22	.80	.00	< .001
Intrusions	-0.01	-.001	.02	.745
Dissociation	-0.01	-.003	.01	.378
Gender	0.11	.02	.09	.257
Weekday	0.00	.004	.00	.370
Weekend	-0.00	-.001	.01	.864
Time of day	-0.00	-.01	.00	.010
Study day	0.02	.01	.00	.000
Distrust (monetary contributions)				
Intercept	21.04	-.09	1.48	< .000
CM	0.02	.02	.06	.783
Momentary negative affect	0.67	.03	.20	.002
CM x Momentary negative affect	0.02	.02	.01	.027
Day negative affect	0.71	.02	.32	.027
Person negative affect	0.49	.02	1.60	.762
Stimulus trustworthiness	-8.90	-.43	.06	< .000
Intrusions	1.63	.03	.22	< .000
Dissociation	0.85	.03	.11	< .000
Gender	-4.10	-.08	4.07	.319
Weekday	-0.07	-.01	.09	.437
Weekend	-0.14	.00	.39	.714
Time of day	0.05	.01	.01	.000
Study day	0.34	.02	.09	.000

Note. Variables were coded as follows: stimulus valence: -9 (fully negative expressed emotion) to 9 (fully positive expressed emotion); stimulus trustworthiness: 0 (low), 1 (medium), 2 (high); intrusions: 0 (not occurred), 1 (occurred); dissociation: 0 (not at all) to 9 (very strongly); gender: 0 (female), 1 (male); weekday: from Sunday (1) to Saturday (7); weekend 0 (weekday), 1 (weekend); time of day (in minutes): 8 a.m. = 0; study day: 1–7.

[a]CM was measured using the Childhood Trauma Questionnaire.

Our second hypothesis was partially supported. We did not observe a significant main effect of CM. In contrast, momentary negative affect was a significant positive predictor of distrust. Additionally, there was a significant CM x negative affect interaction, indicating that the effect of CM on distrust was stronger in moments of elevated negative affect. In light of the nonsignificant CM main effect, the findings suggest that CM only predicted increased distrust in the context of heightened negative affect (see Figure 3 and Tables B4 and B5 in the Appendix Chapter II). Significant covariates were stimulus trustworthiness (i.e., more trustworthy stimuli entailed lower distrust ratings), time of day (i.e., higher distrust later in the day), and study day (i.e., higher distrust later in the study). Additionally, the effects of both intrusions and dissociation were highly significant, suggesting increased distrust at times when the participant experienced intrusions or dissociation.

4.5 Discussion

In a 7-day AA study with preregistered methods, we examined the daily life associations between CM and both behavioral distrust and interpersonal threat sensitivity, both of which are theorized to be consequences of interpersonal trauma (Ehlers & Clark, 2000; Resick & Schnicke, 1993). Additionally, we tested whether distrust, as operationalized by a distrust game, and interpersonal threat sensitivity are increased in states of heightened negative affect, as proposed by the feelings-as-information theory (Schwarz & Clore, 1983). Thereby, we investigated whether momentary negative affect constitutes a context in which the effects of CM are strengthened. We measured behavioral distrust and interpersonal threat sensitivity using two newly developed and carefully evaluated experimental AA paradigms that were successfully applied in a previous study with an independent sample of mentally healthy individuals (Schmitz et al., 2021).

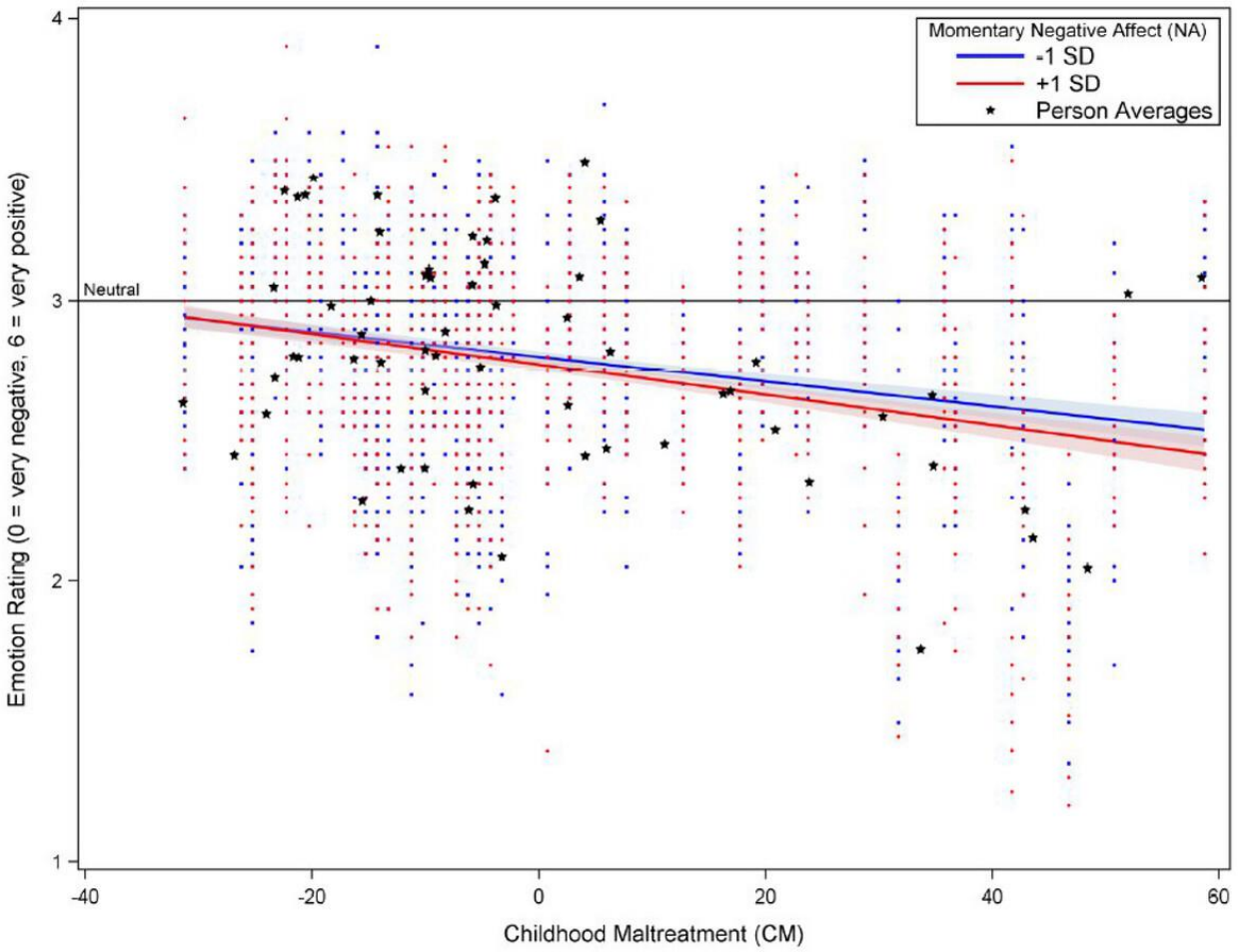

Figure 2. Model plot for the linear mixed-effect model testing the effects of childhood maltreatment (CM)[a], negative affect, and their interaction on emotion ratings.

Note. The grand-mean centered level of childhood maltreatment (CM), measured using the German version of the Childhood Trauma Questionnaire (Bader et al., 2009), is presented on the *x*-axis, and emotion ratings are presented on the *y*-axis. Regression lines are plotted separately for high (+1 standard deviation) versus low (-1 standard deviation) negative affect (interaction term).

[a]CM was measured using the Childhood Trauma Questionnaire.

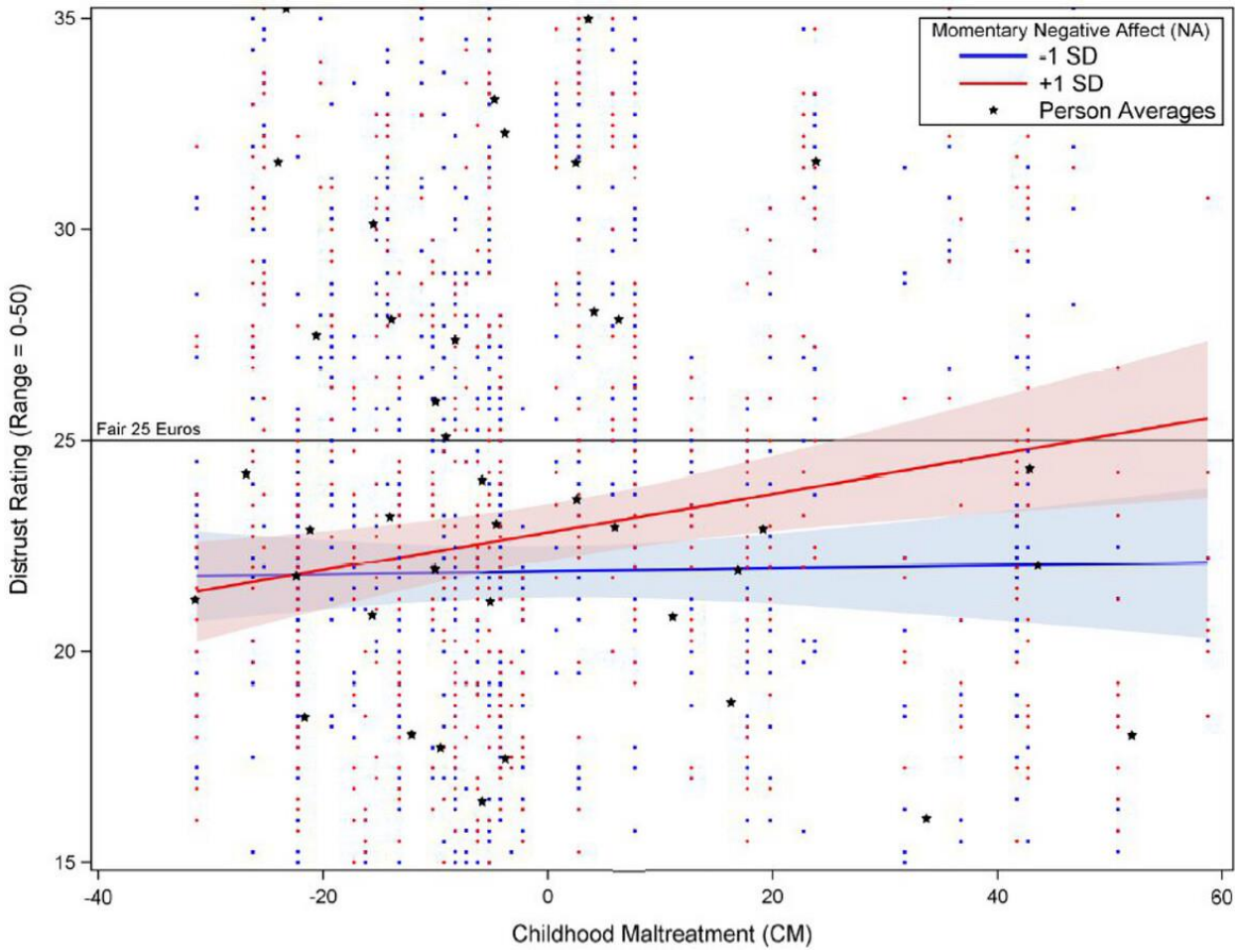

Figure 3. Model plot for the linear mixed-effect model testing the effects of childhood maltreatment (CM)[a], negative affect, and their interaction on distrust ratings.

Note. The grand-mean centered level of childhood maltreatment (CM), measured using the German version of the Childhood Trauma Questionnaire (Bader et al., 2009), is presented on the *x*-axis, and momentary distrust ratings are presented on the *y*-axis. Regression lines are plotted separately for high (+1 standard deviation) versus low (-1 standard deviation) negative affect (interaction term).

[a]CM was measured using the Childhood Trauma Questionnaire.

As predicted, and supporting our first hypothesis, individuals with higher levels of CM rated facial expressions more negatively in the moment. This is in line with cognitive models suggesting that people who have experienced trauma, such as CM, expect others to be potentially threatening (Ehlers & Clark, 2000; Resick & Schnicke, 1993), which can include overattributing negative emotions to neutral faces (see Catalana et al., 2020; Pfaltz et al., 2019). This finding also replicates results from a previous study by Hepp et al. (2021) in which the same paradigm was applied cross-sectionally. Moreover, as hypothesized, momentary negative affect was associated with more negative emotion ratings, supporting the feelings-as-information theory (Schwarz & Clore, 1983). Contrary to our hypotheses, negative affect did not significantly moderate the association between CM and emotion ratings, suggesting that CM and negative affect might independently contribute to increased interpersonal threat sensitivity (see Figure 2). However, the effect sizes of the associations between CM and emotion ratings and between negative affect and emotion ratings were generally small, as commonly observed in AA studies (Hepp et al., 2018), thus warranting further studies to replicate the findings.

Our second hypothesis was partially supported. Contrary to both our expectations and previous cross-sectional findings (Hepp et al., 2021; Pepin & Banyard, 2006; Vaile Wright et al., 2010), CM did not appear to have a significant main effect on momentary distrust. Yet, upon closer inspection, the significant CM x negative affect interaction suggested that CM did have an effect but only at high levels of negative affect (see Figure 3). These results supported our hypothesis that momentary negative affect would strengthen the association between CM and momentary distrust and underline the importance of assessing the affective context when evaluating behavioral distrust. Clinically, this finding is relevant, as it suggests that behavioral distrust is not elevated at every moment during the daily lives of individuals who have experienced CM but rather manifests in states of heightened negative affect. However, as we only measured distrust using a hypothetical economic game, we cannot generalize this result to other types and contexts of distrust. Further studies are needed to replicate these results with paradigms that assess

different manifestations of distrust behavior or are able to capture distrust as it occurs in real-life interactions. This provided, future research should test whether therapeutic approaches that target negative affect regulation could help mitigate distrust behavior in daily life. Lastly, we observed a significant positive association between momentary negative affect and distrust, as predicted based on the feelings-as-information-theory (Schwarz & Clore, 1983). This replicates previous findings by Schmitz et al. (2021) and is in line with findings on mood-congruent trust ratings and behavior (Dunn & Schweitzer, 2005; Mislin et al., 2015). However, also in this second model, the effect sizes were small, and the findings, therefore, need to be interpreted with care. Nonetheless, it has to be taken into account that these are trait x situation interaction effects within a daily life context that is rich in noise and typically produces small effect sizes (Bolger et al., 2003).

The present results should be interpreted in the context of several limitations. First, the generalizability was limited due to the selectiveness of the sample (88.5% white cisgender women). The study was part of a research consortium that recruited widely throughout the region through advertisements placed on public transport, in local newspapers and on newspaper websites, in local clinics, and on social media platforms. Nonetheless, we were unable to recruit a sample that adequately represents the population of individuals affected by CM. Prevalence rates of CM differ substantially by gender and continent (Moody et al., 2018). Epidemiological data on CM prevalence in gender nonconforming and transgender people is largely lacking, but data from small samples suggest elevated rates of CM in this group (Schnarrs et al., 2019). Additionally, the sample included almost exclusively white participants, which poorly reflects the fact that CM is more prevalent in people of color (Mersky & Janczewski, 2018). We assume that despite our best recruitment efforts, this sample is mostly representative of individuals who had previously received or were currently seeking treatment at our clinic.

Second, the study was limited by the hypothetical nature of the distrust game, as participants did not have real interaction partners and incentives (see Hepp et al., 2021). Studies investigating whether individuals behave differently with real interaction partners and incentives

have come to various conclusions, with some demonstrating that hypothetical games are feasible (e.g., Thielmann et al., 2016) and others criticizing this method of assessment (e.g., Baumeister et al., 2007). Future studies could endeavor to replicate the present results, possibly by integrating real-life interaction partners as players in the distrust game.

A third limitation relates to our operationalization of interpersonal threat sensitivity via a valence rating of facial emotional expressions. Although other studies also used negative emotional facial stimuli to assess interpersonal threat sensitivity or threat bias in samples of individuals with a history of trauma (e.g., Bell et al., 2017; Bertsch et al., 2017; Chu et al., 2016; Cowden Hindash et al., 2019; Fonzo et al., 2010; Seitz et al., 2021), it is likely that other factors may have contributed to negative evaluations of facial expressions. Most prominently, current mood has an effect on emotion recognition (Schiffenbauer, 1974; Schmid & Schmid Mast, 2010). In addition, variations of paradigms that were previously used to study threat sensitivity in general, like the threat of predictable and unpredictable aversive events (the NPU threat task; Schmitz & Grillon, 2012) or the Posner spatial orienting paradigm (Posner, 1980; Raymond et al., 2021), could be used to differentiate the effects of general threat sensitivity from interpersonal threat sensitivity by introducing interpersonal stimuli into the experimental design.

Fourth, with negative affect, we assessed only one relevant daily life context for distrust and interpersonal threat sensitivity, and there are likely other relevant everyday contexts that could be addressed in future research. For instance, recent work on trust in everyday life (Weiss et al., 2021) suggests that social distance and power imbalance are important contexts for distrust, and both of these are directly relevant to CM and could inform future work.

To our knowledge, this investigation was the first daily life study to assess behavioral distrust (using a distrust game), interpersonal threat sensitivity (via the evaluation of facial emotions), and their affective context in individuals who have experienced CM. The results suggest that individuals with higher levels of CM tended to perceive facial expressions as more negative, which was independent of the affective context. In contrast, momentary distrust was

only associated with CM at high levels of negative affect. The results indicate that the association between CM and interpersonal threat sensitivity appeared relatively stable in daily life, whereas the association between CM and distrust was limited to the context of heightened negative affect. The findings for both tasks are in line with the feelings-as-information theory (Schwarz & Clore, 1983) and underscore that cognitive alterations surrounding distrust and interpersonal threat sensitivity, which were originally proposed for PTSD (Ehlers & Clark, 2000), also affect individuals who have experienced CM. Future studies with more diverse samples are needed to investigate additional relevant daily life contexts and naturalistic stimuli.

Thesis Discussion

CHAPTER IV

This doctoral thesis includes two empirical studies, aiming to integrate novel paradigms on distrust and emotion processing in an AA framework and to further the understanding of mechanisms that might underlie the restricted interpersonal functioning of individuals with a history of CM. For this purpose, I conducted a first study that tested the implementation of two newly developed experimental paradigms on distrust and emotion processing in the daily lives of healthy individuals and assessed how these constructs are associated with the participants' affective states that they experienced in the same moment. Unlike laboratory studies that depend on artificial mood inductions, AA captures affective states in the participants' natural environments while they undergo daily life activities. Frequent prompts were used to mitigate recall biases commonly encountered in aggregating data across prolonged periods (Solhan et al., 2009). In addition to successfully implementing two novel paradigms in an AA context, the first study partially supported my hypothesis that the momentary mood of the participants influenced their concurrent behavior in the two tasks at a within-person level. As predicted by the feelings-as-information approach (Schwarz & Clore, 1988), participants indicated higher levels of distrust towards the displayed facial stimuli when being in a negative mood. However, the current mood of the participants was not associated with the ratings of facial emotional expressions in this sample.

Based on Study 1, I applied the same paradigms on distrust and emotion processing in a second sample consisting of 61 individuals with varying levels of CM. In Study 2, I focused on the association between CM and distrust/ interpersonal threat sensitivity, assuming that higher levels of CM would entail higher levels of distrust, and a hypersensitivity to interpersonal threat in daily life. Additionally, at a momentary level, I tested whether the current mood of the participants was a relevant context variable that strengthened these associations. Results indicated that individuals with higher levels of CM rated facial emotional expressions more negatively.

Moreover, replicating the mood-congruent effects found in Study 1, participants rated facial emotional expressions more negatively in moments of more negative affect. Contrary to my hypothesis, the level of CM alone was not associated with higher distrust ratings in the distrust game. However, when also taking into account the momentary mood of the participants, the data revealed a significant interaction effect, suggesting that CM did have an effect on momentary distrust at high levels of negative affect. Additionally, I was able to replicate the key finding from Study 1 and demonstrate that participants show higher levels of distrust in moments of more negative affect.

In the following sections, I will summarize the findings from both AA studies and integrate these into the literature on mechanisms underlying interpersonal dysfunction in individuals with a history of CM, highlighting how the results of these two studies add to previous evidence. Additionally, I will summarize the limitations of both publications and finally derive implications for research and clinical practice.

5.1 Summary and Integration of Study Findings

Previous evidence on alterations in social-cognitive processes that might underlie interpersonal dysfunction in individuals with a history of CM is scarce. Studies that have employed facial emotional stimuli in samples of individuals affected by CM have primarily focused on deficits in the recognition of facial emotional expressions (e.g., Catalana et al., 2020; Diaconu et al., 2023; Pfaltz et al., 2019; Seitz et al., 2021). Only one study of our own working group applied an emotion rating task, which focused on directly assessing the valence ratings of different emotional expressions rather than the number of correctly classified emotional expressions (Hepp et al., 2021). This study found negatively shifted or biased emotion ratings in individuals with heightened levels of CM. However, most of the previous studies on emotion processing in individuals affected by CM were of cross-sectional nature and thus did not take into account within-person fluctuations over time. Similarly, evidence of decreased levels of

interpersonal trust in individuals with a history of CM primarily stems from cross-sectional studies. While the majority of these studies utilized self-report measures (e.g., Blanchard-Dallaire & Hébert, 2014; Botsford et al., 2019; Pepin & Banyard, 2006; Vaile Wright et al., 2010), only a few studies applied behavioral tasks to assess behavioral distrust (Hepp et al., 2021; Neil et al., 2021; Sellnow et al., 2021). Consequently, studies assessing the effects of CM on emotion processing and behavioral distrust, also taking into account fluctuations within individuals, are lacking. The current work tries to address these research gaps by adopting an AA approach and measuring mood and behavioral paradigms on distrust and emotion processing multiple times in the daily lives of individuals with a history of CM.

Furthermore, studies on social-cognitive alterations in individuals with a history of CM typically adopted a case-control design, contrasting, for example, individuals with a history of CM with non-traumatized healthy controls or PTSD participants (e.g., Pfaltz et al., 2019). Thus, previous studies largely did not assess the effects of the intensity of CM, and milder intensities of maltreatment often remain unexplored. Therefore, in Study 2, I assessed CM continuously, also including trauma types that would not qualify as a traumatic event based on the DSM-5 PTSD diagnosis (American Psychiatric Association, 2013). Moreover, I adopted a transdiagnostic approach and included both participants with and without mental disorders.

In line with my hypotheses, the results of Study 1 revealed a significant association between the current mood of the participants and concurrent distrust ratings in the distrust game, suggesting higher levels of distrust in moments of more negative affect. This finding is in line with findings from previous laboratory studies on mood-congruent trust ratings (Dunn & Schweitzer, 2005) and mood-congruent trust behavior (Mislin et al., 2015). Furthermore, the current finding extends between-person evidence by demonstrating that interpersonal distrust also varies within the same person on a day-to-day basis, depending on the naturally fluctuating mood of the participants. The finding also supports theoretical assumptions based on the feelings-as-

information theory, that individuals frequently misattribute their own affective state to the judgment at hand (e.g., Schwarz & Clore, 1988).

However, there was no significant association between the current mood of the participants and concurrent emotion ratings in Study 1. This result is in contrast to theoretical assumptions on mood-congruent evaluations and previous findings from laboratory studies, demonstrating an association between the emotional states of the participants and their ratings of facial expressions (Schiffenbauer, 1974; Schmid & Schmid Mast, 2010). One explanation for the non-significant finding could be that the current sample of healthy participants endorsed rather positive affective states, leading to a skewed distribution of the mood variable. The restricted variance of the mood predictor could have per se impeded the detection of existing associations in the sample. Moreover, it is possible that we could not detect a mood-congruent effect in our sample if it was largely driven by negative affect. This is in line with the assumptions of Coupland and colleagues (2004), who reported a differential effect of positive and negative mood on the evaluation of facial emotions.

In Study 2, I demonstrated that individuals with higher levels of CM rated facial emotional expressions more negatively. This finding corroborates the results of a previous study by Hepp et al. (2021), who applied a very similar paradigm in a cross-sectional web-based format. It is further in line with previous laboratory studies demonstrating that individuals affected by CM tend to overattribute negative emotions to neutral faces (Catalana et al., 2020; Pfaltz et al., 2022). The finding is also consistent with cognitive models of PTSD, suggesting that individuals who have experienced trauma, such as CM, tend to perceive others more negatively or as threatening (Janoff-Bulman, 1989; McCann & Pearlman, 1990; McCann et al., 1988; Resick & Schnicke, 1993). As hypothesized, I was further able to replicate mood-congruent associations between the momentary mood of the participants and their concurrent ratings of emotional expressions, indicating more negative ratings in states of heightened negative affect. This finding supports assumptions based on the feelings-as-information theory and is in line with previous empirical

evidence (Schiffenbauer, 1974; Schmid & Schmid Mast, 2010), but is in contrast to the results of Study 1, in which I could not find an association between the current mood of the participants and their evaluation of emotional faces. As described above, the restricted variance of the mood variable in Study 1 (community sample) might have impeded the detection of the hypothesized associations. In Study 2, by contrast, the mood variable was normally distributed, suggesting that this second sample consisting of individuals with a history of CM (including a high percentage of mental disorders; see Table 3) were much more likely to report negative mood than the mentally healthy sample. It is possible that the different distributions of the mood variable in the two samples account for the different findings.

Regarding the distrust game in Study 2, I could not replicate previous cross-sectional work demonstrating a positive association between CM and distrust (Hepp et al., 2021; Pepin & Banyard, 2006; Vaile Wright et al., 2010). However, the present finding is in line with the results of a study by Sellnow et al. (2021) that found no significant difference between girls with and without a history of physical or sexual abuse in the trust game. It is possible that the discrepancies between studies reflect variations in sample composition (e.g., age and types of CM included) and study design (e.g., dimensional vs. between-subjects design, and cross-sectional vs. repeated measurements). The present study was the first to apply a micro-longitudinal AA design that allowed assessing mood and interpersonal distrust repeatedly and directly in the daily lives of individuals with a history of CM. Despite the non-significant main effect of CM on momentary distrust, CM did have a significant effect when simultaneously taking into account the current mood of the participants as a moderator variable (interaction between CM x negative affect). As Figure 3 shows, higher levels of CM predicted more momentary distrust only at high levels of negative affect . This finding indicates that momentary negative affect strengthens the association between CM and momentary distrust and further suggests that it is also important to consider the affective context when assessing momentary behavioral distrust. Additionally, momentary negative affect had a significant and positive main effect on momentary distrust, which replicates

the results of Study 1 and is further in line with laboratory studies on mood-congruent trust ratings and behavior (Dunn & Schweitzer, 2005; Mislin et al., 2015).

In both studies, effect sizes ranged from very small to small, which is important to keep in mind when discussing the results and drawing implications for future research and therapy. However, it is important to note that small effect sizes are a common finding in daily life studies, which are typically rich in noise, particularly when it comes to trait x situation interaction effects (Bolger et al., 2003; Hepp et al., 2018).

5.2 Limitations

The present work aimed to implement experimental tasks in an AA context to study affective and cognitive processes in the participants' natural environments. While addressing several research gaps by applying these novel paradigms using AA (e.g., repeated assessments, assessing within-fluctuations/ contextual factors), the current work has its own limitations. Since Study 2 replicated both paradigms on emotion processing and distrust in another sample, many limitations apply to both studies.

First, there were methodological limitations pertaining to the employed paradigms, the distrust game, and the emotion rating task. A main limitation of the distrust game was its hypothetical nature, since participants neither played with a real interaction partner nor received real money (see Hepp et al., 2021). Previous studies reached different conclusions regarding the hypothetical adaptations of economic games. While some demonstrated that these are feasible (Engel, 2011; Thielmann et al., 2016), others argued that hypothetical behavior differs significantly from actual behavior (Baron, 2001; Baumeister et al., 2007). An advantage of the hypothetical version of the distrust game in this study is that it allowed for greater experimental control, because all participants saw the same avatars. However, future laboratory and AA studies should replicate the results using real interaction partners and incentives.

As discussed in Chapter III, another limitation relates to the emotion rating task, which we used as a proxy for interpersonal threat sensitivity. Negative emotional facial stimuli have frequently been used to assess interpersonal threat sensitivity in individuals with a history of trauma (e.g., Bell et al., 2017; Bertsch et al., 2017; Chu et al., 2016; Cowden Hindash et al., 2019; Fonzo et al., 2010; Seitz et al., 2021). However, the processing of facial emotional expressions is highly complex and likely reflects several other constructs beyond threat sensitivity, which possibly contributed to the negative evaluations of facial expressions. For instance, as demonstrated in the second publication, current mood has an effect on the evaluation of emotional stimuli (Schiffenbauer, 1974; Schmid & Schmid Mast, 2010), so individuals rated pictures of faces more negatively the more negative their current mood was.

In addition to limitations with regard to the employed paradigms, a further limitation was that with negative affect, only one daily life context was assessed. However, it is likely that there are other relevant contextual factors for distrust and interpersonal threat sensitivity. A recent AA study by Weiss et al. (2021) examined several determinants of trust in everyday life beyond the current affect, for instance, power imbalance and social distance, and found considerable variability in trust in these contexts. In addition to being important contexts for trust, these contextual factors might be particularly relevant to individuals with a history of CM. Nonetheless, much more research is needed to identify important contextual factors for distrust and interpersonal threat sensitivity in the daily lives of individuals with a history of CM.

In both studies, the results were based on a selected sample of participants. Study 1 consisted of 42 healthy cisgender women (age: M = 29.88, SD = 7.50, range 21-50), primarily without migration background and without minority affiliations. The use of an exclusively female sample with this age range reduced both the heterogeneity of the assessment of daily-life mood, and the initial evaluation of the two novel paradigms in an AA context. However, the composition of the sample also limited generalization and excluded, for instance, adolescents, elderly individuals, clinical populations, and other sexes or genders. Similarly, Study 2 was restricted

with regard to gender, age, and ethnicity (88.5% were white cisgender women), despite recruiting via various sources online and offline to achieve a sample that represented the population of individuals with a history of CM. Moreover, of the 61 individuals that participated in Study 2 (age: M = 31.52, SD = 10.51, range 19-59), 46 individuals (75.4%) had a lifetime diagnosis of a mental disorder and 37 individuals (60.7%) had previously been in outpatient treatment. Thus, we may have sampled individuals affected by CM who had previously received treatment in our clinic. In order to increase generalizability, it would be necessary to replicate the present findings in more diverse samples.

A further limitation that relates to the sample composition of Study 2 was that, despite referring to cognitive models of PTSD as the theoretical underpinnings, participants did not necessarily fulfill a PTSD diagnosis according to the clinical interviews. In fact, as recruitment was performed transdiagnostically within the GRK2350, only 27.9% of the participants fulfilled the DSM-5 criteria for a current PTSD (34.4% lifetime). However, previous evidence suggests that cognitive alterations in terms of heightened levels of interpersonal distrust and threat sensitivity are also important for those with a history of CM who do not meet the criteria for a PTSD diagnosis (e.g., Blanchard-Dallaire & Hébert, 2014; Catalana et al., 2020; Dodge et al., 1995; Gibb et al., 2009; Hepp et al., 2021; McLaughlin et al., 2020; McLaughlin & Lambert, 2017; Pfaltz et al., 2022; Pfaltz et al., 2019; Pollak et al., 2000; Pollak & Kistler, 2002). In addition to replicating these previous findings with Study 2, a transdiagnostic approach further enabled me to assess the whole range of CM in a dimensional fashion.

The transdiagnostic approach I pursued in Study 2 involved a range of comorbidities in the sample (see Table 3), which are common in individuals with a history of CM (e.g., Messman-Moore & Bhuptani, 2017). At the same time, comorbidity could have had an effect on the results of the study. Although I assessed clinical diagnoses, I did not include these in the analyses. Consequently, it is not possible to conclude whether our findings are specific to the population of individuals with a history of CM or whether they result from increased levels of psychopathology

in general. It is likely that many of the observed effects would be more pronounced in those with a PTSD diagnosis. However, since CM is associated with a range of other mental disorders, disturbances in threat-processing and trust are not restricted to those with PTSD but could also be demonstrated in disorders such as depression (Bourke et al., 2010) and BPD (Unoka et al., 2009). Particularly, BPD is associated with adverse life experiences such as CM (Porter et al., 2020). At the same time, individuals with BPD are prone to misattribute negative emotions to faces depicting neutral expressions (Daros et al., 2013) and exhibit reduced levels of trust in the trust game (Jeung et al., 2016). Both processes could contribute to the high rates of interpersonal problems individuals with BPD frequently experience (Lazarus et al., 2014). At this point, it is unknown whether the experience of CM contributes to these variations in trust and threat perception in BPD. Furthermore, both processes could also contribute to the distinct interpersonal problems individuals with complex PTSD experience (Brewin, 2020). Consequently, future studies could target their recruitment strategy toward assessing CM in different clinical groups.

5.3 Research Implications

The present work has several implications for the improvement of future research on mechanisms underlying interpersonal dysfunction in individuals with a history of CM. Implications regarding the implemented paradigms and stimuli, which are relevant for both studies, will be discussed first.

As discussed in the section above, implementing a hypothetical version of the distrust game implied several advantages (e.g., greater experimental control and less complicated implementation in AA). However, previous work on the comparability of hypothetical versions of economic games and games using real incentives and interaction partners is not conclusive (e.g., Baumeister et al., 2007; Thielmann et al., 2016). Future studies should therefore replicate the present results in samples of individuals with a history of CM, including real interaction partners and incentives. This could be realized in both laboratory studies and AA studies. Whereas

trust games with real incentives and partners have been frequently implemented in previous laboratory studies with clinical populations other than PTSD (e.g., Fett et al., 2012; King-Casas et al., 2008; Sellnow et al., 2021; Zhang et al., 2012) or with non-clinical populations (e.g., Fett, Gromann, et al., 2014; Fett, Shergill, et al., 2014; Houser et al., 2010), the current AA studies are the first to assess behavioral trust in daily life. In addition to assessing trust using real incentives and partners, much more research on the link between trust and CM/ trauma-related disorders is needed, as only a few studies have adopted trust games in such samples.

With regard to the assessment of interpersonal threat sensitivity, future studies could try to replicate the present findings using different paradigms. This would be of particular interest because the evaluation of facial emotional expressions within the emotion rating task as used in this study was likely influenced by several other constructs beyond interpersonal threat sensitivity (e.g., current mood). Other paradigms that were previously used to assess threat sensitivity in general are, for instance, the threat of predictable and unpredictable aversive events (the NPU threat task; Schmitz & Grillon, 2012) or the Posner spatial orienting paradigm (Posner, 1980; Raymond et al., 2021). These paradigms could also help to differentiate the effects of general threat sensitivity from interpersonal threat sensitivity by introducing interpersonal stimuli into the experimental design.

Beyond implications for the assessment of distrust and interpersonal threat sensitivity, future AA studies could further aim to improve the assessment of momentary affect by using separate unipolar items for positive and negative affect. The four items for momentary mood (with the two subscales *valence* and *calmness*) that were used in this study were of bipolar nature. This meant that participants indicated how they felt on a seven-point Likert-type scale ranging from a negative to a positive affective state (e.g., unwell-well) or vice versa (e.g., content-discontent). By comparison, unipolar scales (e.g., Positive and Negative Affect Schedule-Extended Version; PANAS-X; Röcke & Grühn, 2003) focus only on a single item's absence or presence (e.g., guilty, sad) and, therefore, possibly generate more accurate answers. Accordingly, unipolar scales like

the PANAS-X scale typically range from *very slightly or not at all* to *extremely*, whereas bipolar scales have a neutral point in the middle (-3, -2, -1, 0, 1, 2, 3). The bipolar mood scales that we employed in the current studies were time efficient. This is especially relevant in AA studies, where the participant burden should be reduced to a minimum to maintain a good compliance throughout the whole assessment period. However, a separate assessment of positive and negative mood via unipolar items might be conceptually more appropriate (e.g., Schmukle et al., 2002; Watson et al., 1988) and generate more accurate answers, which could also help to test mood-congruent effects in more detail (as positive and negative moods could differently affect the constructs of interest; e.g., Coupland et al., 2004). Therefore, despite contributing to a more intensive study design in terms of a slight increase in prompt duration, it would be important to test whether a separate assessment of positive and negative moods leads to comparable results.

In addition to the current mood, there are further important contexts that future studies could assess when testing the effect of CM on interpersonal distrust and threat sensitivity. For instance, it is possible that distrust and threat sensitivity in individuals with a history of CM also fluctuate depending on interaction partners, the experience of stressful events in general, and/or triggers of traumatic events (Hepp et al., 2021). Thus, participants might be unaffected by distrust when they are surrounded by those they feel close to or when they have experienced a day with few reminders of their traumatic experiences. However, it is possible that the level of distrust increases when participants experience stressful events or are confronted with triggers of their trauma. Weiss et al. (2021) specifically investigated contextual factors for trust within an AA approach. Based on the results of their study, they suggest that social distance and power imbalances are important contexts for distrust. Both of these contextual factors are directly relevant to CM and could inform future work. Likewise, future studies should test whether interpersonal threat sensitivity fluctuates based on these contextual factors. Although the association between CM and interpersonal threat sensitivity appeared relatively stable in the

current work, it is possible that a different picture emerges when assessing positive and negative mood separately or when assessing different contextual factors.

When looking at the sample composition, it would also be important to replicate the present findings with more diverse samples, including, for instance, all ethnicities and genders, to increase the generalizability of the results. Both samples were restricted with regard to these facets and included primarily young women without migration backgrounds. As previously mentioned, Study 2 further included several comorbid conditions (especially PTSD) without testing whether these had an additional effect on the outcome variables. Thus, future studies should aim to target recruitment strategies accordingly. First, they could focus on creating a more heterogeneous sample by addressing specifically elderly individuals, people of color, or people of different ethnicities. The need to increase generalizability especially affects Study 2, as CM and negative (long-term) outcomes of CM were shown to be more prevalent in people of color, in transgender people, and in the LGBTQ+ community (Austin et al., 2016; Maguire-Jack et al., 2020; Mersky & Janczewski, 2018; Schnarrs et al., 2019). Furthermore, examining the associations between distrust, emotion processing and CM in samples of older adults is relevant, as it is not known whether the findings can be replicated when adverse events took place a long time ago or if they happened only recently (Hepp et al., 2021). Second, future studies could include, for instance, more individuals with PTSD to specifically test whether a diagnosis of PTSD increased the observed effects. However, testing further cross-level interactions would also imply aiming for larger sample sizes.

5.4 Clinical Implications

In addition to implications for future research, the present results also have clinical implications that could be relevant for psychotherapy. Results from both studies showed that in moments of negative affect, people might be less trusting and tend to interpret facial expressions negatively. Whereas for the healthy individuals from Study 1, this was only true with regard to

distrust, individuals with a history of CM showed mood-congruent evaluations in both tasks. If this finding was supported by more empirical research, therapeutic approaches could target the regulation of negative affect in patients with a history of CM in order to mitigate negatively biased evaluations of others in states of heightened negative affect. Emotion regulation strategies are the subject of various psychotherapy approaches. One of the most prominent emotion regulation-focused treatments is Linehan's Dialectical Behavior Therapy (DBT; Linehan, 1993). Originally developed to treat suicidal patients diagnosed with BPD, DBT develops a variety of skills to decrease the frequency of intense, negative emotions or increase the ability to cope with distressing emotions (Linehan, 1993, 2014). For instance, these include observing and describing one's own emotions and their functions, checking facts before reacting to emotions, and developing skills to reduce emotional vulnerability in general (e.g., "STRONG skill").

Moreover, results from Study 2 suggest that a history of CM is associated with a tendency to perceive facial expressions as negative and with elevated levels of distrust in states of heightened negative affect. By assessing CM dimensionally, we were able to demonstrate that accumulated experiences of CM intensified this bias or tendency to perceive others as unsafe or negative. Identifying the (transdiagnostic) mechanisms by which CM contributes to interpersonal problems and symptoms of psychopathology may help therapists mitigate the damaging effects of past adversity. It seems likely that the described processes also affect the therapeutic relationship, treatment progress and outcomes, if not adequately addressed by therapists (Hepp et al., 2021). For instance, it is possible that patients with a history of CM are more likely to perceive the therapist's facial expressions as negative and are more distrusting when experiencing negative affect in a therapeutic session. Thus, in further replication of these results, it would be important to address cognitive biases in individuals with a history of CM by utilizing specific psychotherapeutic interventions. For instance, the tendency to perceive others more negatively may be addressed through cognitive reappraisal, a cognitive strategy that alters the meaning or relevance of a stimulus to change the emotional response (Gross, 1998, 2015; Gross & John,

2003). There is some evidence suggesting that the use of cognitive reappraisal can reduce negativity bias (Browning et al., 2010; Raio et al., 2021). With regard to PTSD specifically, Cognitive Processing Therapy (CPT; Resick et al., 2016) aims to identify and modify dysfunctional beliefs originating from traumatic experiences. Therapists could use such CPT interventions, which were originally used to challenge negative beliefs, to address the biases observed in this work (Webb et al., 2023).

In addition to trauma as defined in the formal PTSD diagnosis, Study 2 also included individuals affected by types and intensities of CM that would not qualify as a traumatic event based on DSM-5, demonstrating that these were also associated with increased distrust and a hypersensitivity to interpersonal threats. Thus, the present results suggest that CM could be associated with negative outcomes, even if criteria for PTSD or another trauma-related disorder are not completely met. Within a therapeutic context, it is therefore important to assess all types of CM in detail and consider them as relevant treatment factors in order to select therapeutic interventions and create a stable therapeutic relationship.

Taken together, the studies I have presented in this thesis demonstrate that experimental tasks in AA are feasible. At a within-person level, results showed that momentary affect increased interpersonal distrust in both samples, whereas momentary affect was associated with increased interpersonal threat perception only in individuals with a history of CM. Moreover, the present results indicate that individuals with a history of CM display social-cognitive biases that might be relevant for their interpersonal functioning. Interpersonal threat hypersensitivity and heightened levels of distrust in moments of negative affect may be an important, modifiable treatment target, and therapeutic interventions addressing these may weaken the link between CM and adverse psychosocial outcomes, such as interpersonal dysfunction.

Thesis Summary

Experiencing childhood maltreatment (CM) of any type can have deleterious long-term consequences for development and physical and mental health, such as impairments in various domains of social functioning and a heightened prevalence of psychopathology. Evidence of possible mechanisms that could explain these associations is limited. Cognitive models of PTSD posit that experiencing trauma engenders cognitive alterations, such as hypersensitivity to interpersonal threats and increased distrust towards others. Whereas such cognitive alterations have been primarily proposed for severe forms of trauma, involving threats to life or well-being, little research has explored whether CM, which also includes experiences that are not necessarily life-threatening, might lead to similar negative beliefs. These studies suggest that individuals with a history of CM perceive facial emotional stimuli more negatively and demonstrate higher levels of interpersonal distrust in economic games.

For this thesis, I conducted two ambulatory assessment (AA) studies to examine specific biases in social information processing within the context of daily life experiences. In Study 1, 42 healthy individuals provided data at six random time points throughout the day for seven days. At each random prompt, they rated their momentary mood and participated in two newly developed experimental paradigms on distrust and emotion processing. These processes were assessed in the participants' natural environments while they underwent their normal daily activities. Multilevel models were used to test how distrust and emotion processing were associated with the participants' affective states that they experienced in the same moment. In line with my hypothesis, momentary mood was significantly associated with momentary distrust ratings, suggesting that the more negative a participant's current mood was, the more distrust they experienced at that moment. However, in this sample, the participants' current mood was not associated with the ratings of facial emotional expressions.

Based on Study 1, I applied the same paradigms on distrust and emotion processing in another sample to replicate and extend the findings from Study 1. This second sample consisted of 61 individuals with varying levels of CM. In Study 2, I focused on the association between CM and both distrust and interpersonal threat sensitivity, assuming that higher levels of CM would entail higher levels of distrust and perceived interpersonal threat sensitivity, as postulated by cognitive models of PTSD. At a momentary level, I tested whether the current mood of the participants was a relevant context variable that strengthened these associations. In line with my hypothesis, I found that higher levels of CM were associated with more negative ratings of facial emotional expressions. Furthermore, participants rated pictures of emotional expressions more negatively, the more negative their current mood was. Contrary to my hypothesis, the level of CM alone was not associated with higher distrust in the distrust game. However, data revealed a significant interaction effect, suggesting that individuals with higher levels of CM demonstrate increased momentary distrust in states of heightened negative affect. Additionally, and replicating mood-congruent effects from Study 1, participants demonstrated higher levels of distrust in moments of more negative affect.

To conclude, I was able to successfully implement two novel experimental paradigms into an AA context. At a within-person level, I identified momentary mood as a predictor of interpersonal distrust and the evaluation of emotional faces. Furthermore, higher levels of CM were associated with increased interpersonal threat perception and heightened levels of interpersonal distrust in moments of more negative affect. These results suggest that social-cognitive biases, which were originally proposed for PTSD, also affect individuals with a history of CM. Pending further replication with more diverse samples, the findings offer treatment targets that can be addressed by therapeutic interventions aimed at improving interpersonal functioning in individuals with a history of CM.

Zusammenfassung der Dissertationsschrift

Das Erleben von traumatischen Kindheitserfahrungen jeglicher Art kann langfristig schädliche Folgen für die Entwicklung sowie die körperliche und geistige Gesundheit haben, z.B. bezüglich Beeinträchtigungen in verschiedenen Bereichen des sozialen Funktionsniveaus und eine erhöhte Prävalenz von Psychopathologie. Es gibt nur wenig Forschung zu möglichen Mechanismen, die diese Zusammenhänge erklären könnten.. In kognitiven Modelle der PTBS wurde postuliert, dass das Erleben eines Traumas kognitive Veränderungen hervorrufen kann, beispielsweise eine Überempfindlichkeit gegenüber interpersonellen Bedrohungen und ein erhöhtes Misstrauen gegenüber anderen. Während solche kognitive Veränderungen in erster Linie für schwere Formen von Traumatisierung vorgeschlagen wurden, die eine Gefahr für das eigene Leben oder die körperliche Unversehrtheit darstellen, gibt es nur wenige Studien, die untersucht haben, ob auch andere traumatische (nicht unbedingt lebensbedrohliche) Kindheitserfahrungen zu ähnlichen negativen Überzeugungen führen können. Diese Studien deuten darauf hin, dass auch Personen mit solchen aversiven Kindheitserfahrungen emotionale Gesichtsausdrücke negativer wahrnehmen und ein höheres Maß an interpersonellem Misstrauen in ökonomischen Spielen zeigen.

Für diese Dissertation wurden zwei ambulatory assessment (AA)-Studien durchgeführt, um spezifische Verzerrungen bei der Verarbeitung sozialer Informationen im Kontext alltäglicher Lebenserfahrungen zu untersuchen. In Studie 1 stellten 42 gesunde Personen sieben Tage lang zu sechs zufälligen Zeitpunkten im Laufe des Tages Daten zur Verfügung. Bei jeder zufälligen Eingabe bewerteten sie ihre momentane Stimmung und bearbeiteten die beiden neu entwickelten experimentellen Paradigmen zu Misstrauen und Emotionsverarbeitung. Diese Prozesse wurden in der natürlichen Umgebung der Teilnehmer:innen erfasst, während sie ihren normalen Alltagsaktivitäten nachgingen. Mithilfe von Mehrebenenanalysen wurde untersucht, wie Misstrauen und Emotionsverarbeitung mit den affektiven Zuständen der Teilnehmer:innen

zusammenhingen, die sie im selben Moment erlebten. Gemäß vorliegender Hypothese zeigte sich ein signifikanter Zusammenhang zwischen der aktuellen Stimmung und den momentanen Misstrauensbewertungen. Dies deutet darauf hin, dass Teilnehmer:innen, die eine negativere Stimmung berichteten, in diesem Moment auch ein höheres Maß an Misstrauen zeigten. Allerdings hing die aktuelle Stimmung der Teilnehmer:innen in dieser Stichprobe nicht mit der Bewertung emotionaler Gesichtsausdrücke zusammen.

Basierend auf Studie 1 wurden dieselben Paradigmen zu Misstrauen und Emotionsverarbeitung in einer weiteren Stichprobe angewendet, um die Ergebnisse aus Studie 1 zu replizieren und zu erweitern. Diese zweite Stichprobe umfasste 61 Personen mit variierender Schwere von traumatischen Kindheitserfahrungen. In Studie 2 wurde der Fokus auf den Zusammenhang zwischen traumatischen Kindheitserfahrungen und Misstrauen sowie interpersoneller Bedrohungssensitivität gelegt. Im Zuge dessen wurde hypothetisiert, dass höhere Ausprägungen bezüglich traumatischer Kindheitserfahrungen ein höheres Misstrauen sowie eine höhere wahrgenommene interpersonelle Bedrohungssensitivität mit sich bringen würden, wie von kognitiven Modellen der PTBS postuliert. Auf momentaner Ebene wurde getestet, ob die aktuelle Stimmung der Teilnehmer:innen eine relevante Kontextvariable darstellte, die diese Zusammenhänge verstärkte. Im Einklang mit vorliegender Hypothese konnte festgestellt werden, dass höhere Ausprägungen bezüglich traumatischer Kindheitserfahrungen mit einer negativeren Bewertung emotionaler Gesichtsausdrücke einherging. Darüber hinaus bewerteten die Teilnehmer:innen emotionale Gesichtsausdrücke umso negativer, je negativer ihre aktuelle Stimmung war. Entgegen der vorliegenden Hypothese hing das Ausmaß traumatischer Kindheitserfahrungen allein nicht mit einem höheren Misstrauen zusammen. Die Daten zeigten allerdings einen signifikanten Interaktionseffekt, was darauf hindeutet, dass Personen mit höheren Ausprägungen von traumatischen Kindheitserfahrungen insbesondere in Zuständen mit erhöhtem negativem Affekt ein erhöhtes Misstrauen zeigen. Zudem zeigten die Teilnehmer:innen ein

höheres Maß an Misstrauen in Momenten mit negativerem Affekt, womit die stimmungskongruenten Effekte von Studie 1 repliziert werden konnten.

Zusammenfassend konnten zwei neu entwickelte experimentelle Paradigmen erfolgreich in einen AA-Kontext implementiert werden. Auf momentaner Ebene wurde die momentane Stimmung als Prädiktor für interpersonelles Misstrauen und die Bewertung emotionaler Gesichter identifiziert. Darüber hinaus waren höhere Ausprägungen von traumatischen Kindheitserfahrungen mit einer erhöhten interpersonellen Bedrohungssensitivität und einem erhöhten interpersonellen Misstrauen bei gleichzeitig vorliegendem negativem Affekt assoziiert. Diese Ergebnisse legen nahe, dass sozial-kognitive Verzerrungen, die ursprünglich für die PTBS postuliert wurden, auch Personen mit traumatischen Kindheitserfahrungen betreffen, die nicht die formalen Kriterien für eine PTBS erfüllen. Eine Replikation der Ergebnisse mit vielfältigeren Stichproben vorausgesetzt, bieten die Ergebnisse der Studien Anknüpfungspunkte für mögliche therapeutische Interventionen– mit dem Ziel, die interpersonelle Funktionsfähigkeit von Personen mit traumatischen Kindheitserfahrungen zu erhöhen.

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Publications

Hepp, J., Carpenter, R. W., Störkel, L. M., **Schmitz, S. E.**, Schmahl, C., & Niedtfeld, I. (2020). A systematic review of daily life studies on non-suicidal self-injury based on the four-function model. *Clinical Psychology Review*, *82*, 101888. https://doi.org/10.1016/j.cpr.2020.101888

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Appendix Chapter I

Diagnostic Process

To assess whether participants suffered from any current or past mental disorder, interviewers administered the German Version of the Structured Clinical Interview for DSM-IV (SCID-I; Wittchen et al., 1997) and the International Personality Disorder Examination (IPDE; Loranger et al., 1998). Interviewers were trained master's level psychologists or licensed clinicians. All 44 participants were female and did not meet any current or lifetime mental disorder, including personality disorders. Further exclusion criteria were a developmental disorder, autism spectrum disorder, and current psychotropic medication.

Power-Analysis

We calculated an a-priori power-analysis to determine the required sample size for the hypothesized within-person effects at the momentary level. In detail, we made the following assumptions: We aimed to run our study for seven days with six daily prompts. We considered six the minimum number of random prompts per day that were needed to adequately cover participants' wake-time without overly lengthy intervals between prompts. Therefore, our level 1 sample size was set to 42. We estimated power for a standardized effect size for the level 1 fixed effect = .10 (small). We set the significance level $\alpha = .05$. Based on recommendations for setting parameters given by Arend and Schäfer (2019), we set the ICC for level 2 = .30 (medium) and the standardized effect size for the random slope variance = .09 (medium). Finally, we set the slope-intercept covariance to 0 to achieve a generally conservative power estimate. We then simulated the power that this combination of parameters would yield based on different sample sizes (with 1000 iterations each), and determined a sample size of 40 sufficient to yield a power for the within-effect of >.90. We initially recruited slightly more than 40 participants (44), because it is our experience that some participants drop out during AA studies or that technical difficulties (e.g., the app crashing) can lead to some participants

needing to be excluded (as was the case here with $n = 2$ participants). Thus, we arrived at our final sample size of $N = 42$.

Model Equations

To test hypothesis 1, that current mood positively predicts facial emotion ratings, we conducted one MLM using emotion ratings of the positive stimuli, and one MLM using emotion ratings of the negative stimuli as the criterion. We entered the following predictors in both models: momentary mood, day-level mood, person-level mood, and intensity (0 = neutral expression to 9 = full emotional expression), which was centred on the grand mean. The corresponding three-level emotion model equation is:

$$EMO_{ijk} = (b_0 + b_{0i} + b_{0j(i)}) + (b_1 + b_{1i})*MOOD\_mom_{ijk} + (b_2 + b_{2i})*MOOD\_day_{ij} + b_3*MOOD\_person_i + b_4*Intensity_{ijk} + b_5*Weekday_{ij} + b_6*Timeday_{ijk} + b_7*Studyday_{ij} + e_{ijk}$$

In this model, EMO_{ijk} is the momentary emotion rating of person i on day j at occasion k. At a given occasion k, an individual's EMO score is fit as a function of a global intercept (b_0), as well as the current moment's mood (i.e., MOOD; b_1), an individual's average MOOD for that day (b_2), and an individual's overall person-average MOOD across the entire AA period. In addition to the MOOD effects, there are also momentary intensity of the stimulus (b_4), the day of the week (Weekday; b_5), the time of day of the week (Timeday; b_6), and the particular study day (Studyday; b_6). Model effects not indexed by i (person) or j (day) were all estimated as fixed, between-person effects. Also estimated are four random effects. The first is a random intercept for individuals (b_{0i}), such that across the diary period some individuals might report higher/lower emotion ratings than others on average. The second is a random intercept for days nested within individuals ($b_{0j(i)}$), such that some days for a particular individual might be associated with higher/lower emotion ratings than others. The third and fourth are person-level random slopes for the momentary- and day-level MOOD effects (b_{1i}, b_{2i}), which allow a

particular individual's association between a current moment's and day's MOOD, and their momentary emotion ratings, to differ from the overall sample effects. All random effects were estimated to be normally distributed with means of zero and free variances while also being constrained to be uncorrelated within level. Finally, there is an error term (e_{ijk}).

To test hypothesis 2, that current mood negatively predicts distrust ratings, we conducted a MLM using distrust ratings (i.e., how much money participants thought target persons would take from them) as outcome. As above, we included main effects for the predictors momentary mood, day-level mood, person-level mood, and stimulus intensity (0=low, 1=medium, 2=high trustworthiness), centred on the average stimulus intensity. The corresponding three-level trust model equation is:

$$TRUST_{ijk} = (b_0 + b_{0i} + b_{0j(i)}) + (b_1 + b_{1i})*MOOD\_mom_{ijk} + (b_2 + b_{2i})*MOOD\_day_{ij} + b_3*MOOD\_person_i + b_4*Trustworthy_{ijk} + b_5*Weekday_{ij} + b_6*Timeday_{ijk} + b_7*Studyday_{ij} + e_{ijk}$$

In this model, all model effects were identical as before except trust ratings were included as the dependent variable and a trustworthiness indicator of the stimulus was included as a covariate in place of the emotion stimulus' intensity.

Reliability Analyses

We computed reliabilities following the procedure outlined in Shrout and Lane (2012). In detail, we first conducted a variance decomposition and then calculated R_{KR}, which is the between-person reliability of average levels across time points according to the following formula, where k is the number of time points, and m is the number of item reports (across k time-points):

$$R_{KR} = \frac{(\sigma^2_{ID} + \frac{\sigma^2_{person*time}}{m})}{(\sigma^2_{ID} + \frac{\sigma^2_{person*time}}{m} + \frac{\sigma^2_{time}}{k} + \frac{\sigma^2_{person*time}}{k} + \frac{\sigma^2_{Residual}}{km})}$$

We next computed R_C, which is the reliability of within-person change in ratings over time according to:

$$R_C = \frac{\sigma^2_{person*time}}{(\sigma^2_{person*time} + \frac{\sigma^2_{Residual}}{m})}$$

Validity of Mood Assessment

Following the suggestion by an anonymous reviewer, we conducted additional analyses to test the validity of our mood assessment (see Table A4). Our aim was to replicate previously reported mood dynamics, specifically findings that mood tends to improve throughout the day (e.g., Díaz-Morales et al., 2015), and that people tend to be in a better mood during weekends rather than weekdays (e.g., Stone et al., 2012). To model mood trajectories throughout a day, we used time of day (in minutes; with 8 a.m. being coded as 0) to predict momentary mood. Time of day was significantly and positively associated with momentary mood, indicating that participants' moods brightened in the course of a day (Est = 0.01, β = 0.05, SE = 0.00, $p < .001$). Similarly, as mood shows considerable between-day variation (Wilhelm & Grossman, 2010), we tested whether momentary mood varied depending on whether it was a weekday or weekend. We found that weekend (0 = weekday and 1 = weekend) was significantly and positively associated with momentary mood in our sample (Est = 0.23, β = 0.09, SE = 0.01, $p < .001$). This suggests that participants' mood was more positive on the weekend compared to momentary mood on a weekday, which is a common finding in the literature.

Intraclass Correlation Coefficients

ICCs were calculated by dividing the proportion of momentary/person variance of the respective random effects to the total variation across all ratings and all individuals. For this purpose, null models without predictors were computed for mood, the emotion rating task (positive and negative stimuli), and the distrust game separately.

Additional Analyses

Two-Level Models

As suggested by an anonymous reviewer, we also conducted two-level models in addition to the three-level models that we report in the manuscript (see Table A5). In this model, we only included within-person predictors at Level-1 and between-person predictors at Level-2. As in the three-level models, we modelled random intercepts for each person, random slopes for momentary affect, and adjusted for the effects of the covariates weekday, study day, and time of day. We centred momentary mood on the participant's person mean and person-level mood on the grand mean. These two-level models were estimated as follows:

$$EMO/TRUST_{ijk} = (b_0 + b_{0i}) + (b_1 + b_{1i})*MOOD\_mom_{ijk} + b_2*MOOD\_person_i + b_3*Trustworthy_{ijk} + b_4*Weekday_{ij} + b_5*Timeday_{ijk} + b_6*Studyday_{ij} + e_{ijk}$$

In this model, all model effects were identical to the respective emotion and trust models as before except for the removal of the day-level random intercept and the day-level fixed effect of mood.

As can be seen in Table A5, the significant effect of momentary mood on distrust ratings was no longer observed in a two-level model. However, not including the day-level worsened the fit of our models, as confirmed by multilevel model fit statistics. We, therefore, chose the three-level modelling approach, as we assumed that day-level processes/experiences were an important unit of analysis that momentary processes should be compared against. We also consider the modelling of the day-level most consistent with the findings from the supplemental models another reviewer requested, which showed that there are meaningful mood effects at the day level (see Validity of Mood Assessment).

Interaction Model (Emotion Rating Task)

In addition to the models that we conducted for positive and negative stimuli separately when predicting the evaluation of facial affect by momentary mood, we computed a model with all stimuli, as suggested by an anonymous reviewer (see Table A6). In this model, we included a dummy variable that coded whether a negative (0) or a positive stimulus (1) was presented (stimulus valence). Results showed that momentary mood was not significantly associated with the emotion ratings. The non-significant interaction further indicated that momentary mood did not differentially affect the ratings of positive vs. negative faces. However, stimulus valence alone was a significant predictor: positive stimuli were rated as more positive by the participants.

Table A 1

Demographic data

Variable	*n*	%
Housing situation		
Alone	13	31.95
With partner/ own family	16	38.09
With parents	1	2.38
Shared apartment	12	28.57
Relationship status		
Single	31	73.81
Married	7	16.67
Long-term relationship	4	9.52
School education		
Graduation after 10 yrs	5	11.90
Graduation after 12-13 yrs	37	88.09
Vocational training		
None	9	21.43
Apprenticeship	6	14.29
University	27	64.28

Note. Graduation after 10 years = German “Realschulabschluss”, graduation after 12-13 years = German “Abitur”.

Table A 2

Means, Standard deviations and ranges for mood and the distrust and emotion ratings

Variable	*M*	*SD*[a]	*Min*	*Max*
Momentary mood	4.56	0.78	0.25	6.00
Person mood	4.53	0.81	2.77	5.99
Momentary distrust ratings	16.94	12.54	0.00	50.00
Person distrust ratings	17.08	8.33	0.38	34.23
Momentary emotion ratings				
Positive stimuli	3.86	1.25	0.00	6.00
Negative stimuli	1.93	1.01	0.00	6.00
Person emotion ratings				
Positive stimuli	3.86	0.21	3.44	4.36
Negative stimuli	1.93	0.27	1.13	2.36

Note. [a]SD momentary level = mean of all within-person standard deviations; SD person level = between-person standard deviation.

Table A 3

Between-person and within-person correlations for mood and the distrust and emotion ratings

	Mood	Distrust ratings	Emotion ratings: positive stimuli	Emotion ratings: negative stimuli
Mood	-	.10	-.00	-.12
Distrust ratings	.01	-	-.07	.00
Emotion ratings: positive stimuli	-.00	-.00	-	-.09
Emotion ratings: negative stimuli	.01	-.01	.00	-

Note. Between-person correlations above the diagonal, average within-person correlations below the diagonal.

Table A 4

Results from two linear multilevel models predicting momentary mood with time of day and weekend

Outcome and predictor	*Estimate*	*β*	*SE*	*p*	*CI low*	*CI high*
Momentary mood						
Time of day	0.01	.05	.00	<.001	.04	.06
Momentary mood						
Weekend	0.23	.09	.01	<.001	.09	.10

Note. Est. = Estimate. Time of day: in minutes, with 8 a.m. being 0. Weekend: 0 = weekday, 1 = weekend.

Table A 5

Results from three additional linear mixed effects models predicting the emotion ratings (positive and negative stimuli separately) and the distrust ratings with momentary and person-level average mood, intensity of the stimulus material, weekday, time of day and study day

Outcome and predictor	*Estimate*	*β*	*SE*	*p*	*CI low*	*CI high*
Model 1a: Emotion ratings (positive stimuli)						
Momentary mood	0.01	.00	.01	.448	-.01	.01
Person mood	-0.00	.00	.04	.921	-.05	.05
Intensity	0.36	.81	.00	<.001	.80	.81
Weekday	0.01	.02	.00	.001	.01	.02
Time of day	-0.00	-.01	.00	.098	-.02	.00
Study day	0.01	.01	.00	.042	.00	.02
Model 1b: Emotion ratings (negative stimuli)						
Momentary mood	0.01	.01	.01	.395	-.01	.03
Person mood	-0.03	-.02	.05	.532	-.10	.05
Intensity	-0.24	-.64	.00	<.001	-.65	-.63
Weekday	-0.01	-.02	.00	<.001	-.04	-.01
Time of day	-0.00	-.01	.00	.238	-.02	.00
Study day	0.01	.03	.00	<.001	.02	.04
Model 2: Distrust ratings						
Momentary mood	0.10	.01	.30	.745	-.03	.04
Person mood	1.00	.05	1.63	.544	-.11	.21
Trustworthiness	-9.41	-.49	.07	<.001	-.50	-.48
Weekday	-0.06	-.01	.03	.066	-.02	.00
Time of day	0.00	.03	.00	<.001	.02	.03
Study day	0.46	.06	.03	<.001	.05	.07

Note. Est. = Estimate.

Table A 6

Results from a linear multilevel model predicting the emotion ratings with momentary and person mood, the interaction momentary mood x valence, intensity of the stimulus material, weekday, time of day and study day

Outcome and predictor	*Estimate*	*β*	*SE*	*p*	*CI low*	*CI high*
Emotion ratings						
Momentary mood	-0.00	.00	.01	.786	-.01	.00
Valence	1.93	.64	.01	<.001	.63	.64
Momentary mood x valence	-0.01	.00	.02	.694	-.01	.01
Person mood	-0.02	-.01	.03	.468	-.04	.02
Intensity	0.07	.13	.00	<.001	.12	.14
Weekday	-0.00	.00	.00	.573	-.01	.01
Time of day	-0.00	.00	.00	.745	-.01	.01
Study day	0.01	.01	.00	.001	.01	.02

Note. Est. = Estimate.

Appendix Chapter II

Table B 1

EMA protocol

Reporting Criterion recommended by Trull & Ebner-Priemer (2020)	**Details from the present study**
Justify sample size (e.g., using a multilevel power analysis)	We pre-registered a sample size of 70 individuals.
Explain rationale for the sampling design (e.g., random, event-based, etc.)	We sampled at six semi-random time-point throughout the day. We wanted to capture different levels of momentary negative affect, in which participants then completed the two paradigms. An event-based design would not have been feasible here as we would have had to instruct participants to self-initiate the app at different levels of negative affect (e.g., when they are feeling very negative, neutral, positive), which can be difficult for participants to complete.
Explain rationale for sampling density (e.g., assessments per day) and scheduling (i.e., when the assessments are scheduled)	We sampled at six semi-random time-points between 8am and 10pm and implemented a minimum spacing of one hour between prompts. This way, we aimed to balance participant burden (i.e., not presenting too many prompts throughout the day) and coverage of different negative affect levels spread out across the day.
Provide technical details of sampling (e.g., prompting and recording practices; procedures for event-based entries; ability to suspend/delay responses; branching details, triggering assessments, follow-ups or dense sampling of events/experiences)	Prompts were presented at six semi-random time-points via audible beep and opening of the study app on screen. Participants had the opportunity to delay prompts by 5, 10 or 15 minutes up to three times, after which they received another reminder to complete the prompt. During each prompt, participants first completed self-reports and then 20 trials (with randomly drawn stimuli) for the distrust game and emotion rating task. The order of the two paradigms was randomized.
Report full text of items, rating timeframes, response options/scaling	Self-report items are described in the main manuscript and exemplary trials for the distrust game and emotion rating tasks are depicted in Figure 1.
Report psychometric properties of items in the current EMA-study (between- and within-person), as well as the origin of the items	The origin of all items is described in the main text of the manuscript, and reliabilities for momentary negative affect, the distrust game, and the emotion rating task are given.
Fully describe hardware and software used	The study phone was a Moto E, 2nd generation running the movisensXS app (Movisens GmbH, Karlsruhe, Germany, Version 1.4.8).

Define valid and missing data (for participants broadly, and specific to individual EMA reports); report descriptive analyses regarding valid data (e.g., mean per person, range, % participants above and below 80% threshold), systematic influences of compliance rates, justification for thresholds for compliance necessary	A random prompt counted as completed if participants had entered the self-report data and finished all trials in both paradigms. Compliance was very high, with 90.54% of random prompts completed (2,295 total prompts). This resulted in 45,900 trials completed for each paradigm over 421 person days. Six days were completely missing, due to two participants who missed all six prompts on these days.
Describe the procedures used to enhance compliance and participation (e.g., remuneration schedule, participant training)	Participants were trained in the use of the smartphone during an orientation session and the experimenters were available by phone throughout the study period if any technical difficulties or questions regarding the study occurred. Participants were paid a compensation of 70€, and a bonus of 30€ if they completed more than 90% of prompts.
Describe the final data set number of reports (total; person average; group average), days in study and retention rates, and rates of delayed or suspended responding (if applicable)	The data of 61 participants is reported, including 2,295 total prompts, with 45,900 total trials completed for each paradigm over 421 person days.
Preparation for data analyses describe centering of predictor variables and at what level; report covariates included in the models	Centering and covariates are described in detail in the main manuscript and in the data analytic code provided on https://osf.io/zfsd9/.
Data analysis Describe levels of analysis (momentary, day, person); explain how time is taken into account in analyses; specify and justify choices of random versus fixed effects in models; describe analytic modeling used as well as statistical software used	Data analytic details are presented in the main manuscript and all code is available at https://osf.io/zfsd9/.

Table B 2

Means, standard deviations, ranges and classification of the CTQ (mild, low, moderate, severe)

Variable	*M*	*SD*	*range*	*% mild*	*% low*	*% moderate*	*% severe*
CTQ sum score	58.26	21.69	27-117				
Emotional neglect	15.49	6.07	5-25	18.03	24.59	18.03	39.34
Emotional abuse	14.85	5.67	5-25	16.39	18.03	18.03	47.54
Physical neglect	9.15	4.13	5-21	47.54	13.11	21.31	18.03
Physical abuse	9.05	4.86	5-23	52.46	16.39	11.48	19.67
Sexual abuse	9.72	6.36	5-25	47.54	4.92	19.67	27.87

Note. Cut-off scores for mild, low, moderate, and severe childhood maltreatment (CM) based on Bernstein & Fink (1998).

Table B 3

Intercorrelations of the CTQ subscales

	Emotional neglect	Emotional abuse	Physical neglect	Physical abuse	Sexual abuse
Emotional neglect	-	.81**	.64**	.55**	.31**
Emotional abuse		-	.62**	.63**	.43**
Physical neglect			-	.75**	.47**
Physical abuse				-	.62**
Sexual abuse					-

Note. * indicates $p < .05$; ** indicates $p < .01$.

Table B 4

Results for two multilevel models using emotion ratings as outcomes predicted by momentary negative affect, childhood maltreatment (CM), and covariates. CM was centered on its -2SD and +2SD values to illustrate effects of negative affect at high and low levels of CM (cf. Figure 2)

Outcome and predictor	*Estimate*	*β*	*SE*	*p*
Emotion ratings (CM centered on -2SD)				
Intercept	2.72		.04	< .001
CM at -2SD	-0.01	-.07	.00	.003
Momentary negative affect	0.00	-.01	.02	.964
CM at -2SD * momentary negative affect	-0.00	-.01	.00	.214
Day negative affect	-0.01	-.00	.01	.368
Person negative affect	-0.04	-.02	.04	.267
Stimulus valence	0.22	.80	.00	< .001
Intrusions	-0.01	-.00	.02	.745
Dissociation	-0.01	-.00	.01	.378
Gender	0.11	.02	.09	.257
Weekday	0.00	.00	.00	.370
Weekend	-0.00	-.00	.01	.864
Time of day	-0.00	-.01	.00	.010
Study day	0.02	.01	.00	.000
Emotion ratings (CM centered on +2SD)				
Intercept	2.72		.04	< .001
CM at +2SD	-0.01	-.07	.00	.003
Momentary negative affect	-0.04	-.01	.02	.028
CM at +2SD * momentary negative affect	-0.00	-.01	.00	.214
Day negative affect	-0.01	-.00	.01	.368
Person negative affect	-0.04	-.02	.04	.267
Stimulus valence	0.22	.80	.00	< .001
Intrusions	-0.01	-.00	.02	.745
Dissociation	-0.01	-.00	.01	.378
Gender	0.11	.02	.09	.257
Weekday	0.00	.00	.00	.370
Weekend	-0.00	-.00	.01	.864
Time of day	-0.00	-.01	.00	.010
Study day	0.02	.01	.00	.000

Note. Est. = Estimate.

Table B 5

Results for two multilevel models using distrust ratings as outcomes predicted by momentary negative affect, childhood maltreatment (CM), and covariates. CM was centered on its -2SD and +2SD values to illustrate effects of negative affect at high and low levels of CM (cf. Figure 3)

Outcome and predictor	*Estimate*	*β*	*SE*	*p*
Distrust ratings (CM centered on -2SD)				
Intercept	20.28		3.12	<.001
CM at -2SD	0.02	.02	.06	.782
Momentary negative affect	-0.28	.03	.47	.557
CM at -2SD * momentary negative affect	0.02	.02	.01	.027
Day negative affect	0.71	.02	.32	.027
Person negative affect	0.49	.02	1.60	.762
Stimulus Trustworthiness	-8.90	-.43	.06	<.001
Intrusions	1.63	.03	.22	<.001
Dissociation	0.85	.03	.11	<.001
Gender	-4.10	-.08	4.08	.319
Weekday	-0.07	-.00	.09	.437
Weekend	-0.14	-.00	.39	.714
Time of day	0.05	.01	.01	<.001
Study day	0.34	.02	.09	<.001
Distrust ratings (CM centered on +2SD)				
Intercept	20.28		3.12	<.001
CM at +2SD	0.02	.02	.06	.783
Momentary negative affect	1.61	.03	.46	<.001
CM at +2SD * momentary negative affect	0.02	.02	.01	.027
Day negative affect	0.71	.02	.32	.027
Person negative affect	0.49	.02	1.60	.762
Stimulus Trustworthiness	-8.90	-.43	.06	<.001
Intrusions	1.63	.03	.22	<.001
Dissociation	0.85	.03	.11	<.001
Gender	-4.10	-.08	4.08	.319
Weekday	-0.07	-.00	.09	.437
Weekend	-0.14	-.00	.39	.714
Time of day	0.05	.01	.01	<.001
Study day	0.34	.02	.09	<.001

Note. Est. = Estimate.