Specific types of childhood abuse and neglect and profiles of adult emotion dynamics

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Keywords: Physical, sexual, and emotional abuse and neglect; EMA

Author contribution: SM and BJ conceived the analyses strategy. PJ and BJ organized the HowNutsAreTheDutch crowdsourcing study and acquired funding and provided the data. MS analyzed the data. All authors made significant contributions to the content of the paper and interpretations of the results.

Acknowledgement. We thank all participants and collaborators of the HowNutsAreTheDutch study for their valuable contribution. Bertus Jeronimus was supported by a grant from the Dutch Research Council (NWO.016.Veni.195.405).
Abstract

Childhood maltreatment (CM) is experienced by ~40% of all children at major personal and societal costs. Studies show adverse consequences of CM on emotional functioning and regulation. This article focuses on differential imprint of emotional, physical, and sexual abuse and/or neglect experiences during childhood on emotional functioning later in life. To study this, we calculated how intense, variable, unstable, inert, and diverse the daily emotions were of 290 Dutch adults (aged 19-73, measured thrice daily during 30 days (90 measurements per person, for five emotion dynamic indices). Participants described abuse/neglect retrospectively using the Childhood Trauma Questionnaire (CTQ). In our structural equation model (SEM), only physical abuse was unrelated to all five emotion dynamic indices. Abuse and neglect showed specific patterns, e.g., emotional abuse, sexual abuse, and physical neglect associated mostly with negative emotions, and emotional neglect predominantly with positive emotion dynamics. CM types were associated differentially with low versus high arousal emotion dynamics (i.e., sexual abuse associated with increased and emotional neglect with reduced emotion dynamics). Dissecting CM effects on adult emotion dynamics may inform theories on the ontogenesis and functioning of emotions, theories on abuse and neglect and the prevention of their developmental sequelia, and help to identify and understand well-adjusted and (dys-)functional emotional development.
**Introduction**

Childhood maltreatment (CM) is a common experience reported by ~40% of people around the world (Stoltenborgh et al., 2015). European community estimates of emotional neglect (~18%) and abuse (~29%), physical neglect (~16%) and abuse (~23%), and sexual abuse (~10%) identify these five types of CM as a key societal issue (e.g., Gilbert et al., 2009; Sethi et al., 2013). Childhood maltreatment compromises children's health, development and dignity, which can have drastic downstream consequences, including heightened risk of developing depression, suicidality, obesity, and substance abuse (psychological consequences), as well as heart disease, cancer, stroke, diabetes, and inflammation (somatic consequences), which are the leading causes of death and disability worldwide, and convey a major personal, financial, and societal burden (Cuijpers et al., 2011; Hughes et al., 2021; WHO, 2006; Sethi et al., 2013; Coelho et al., 2014). One major explanatory mechanism that may link CM to health outcomes is emotion (dys-)functioning (e.g., Sheppes et al., 2015).

The World Health Organization (WHO, 2006) defined childhood maltreatment as different types of abuse, neglect, and exploitation of children by a caretaker or close family member (>80% of all instances) or authority agent, friends, strangers, or health care workers (Gilbert et al., 2009; Scher et al., 2004). There are practical differences between CM types, such as the signs of physical abuse being typically visible (e.g., bruising, scratches, burns, scars), whereas emotional and sexual abuse are largely out of sight, and rely on the child's statement (see Table 1). Partly, therefore, there may also be grave underreporting of specific CM types (Gilbert et al., 2009). Therefore we should be careful when comparing CM types, but also examine potential unique patterns of emotion dynamics, as different types of CM are known to increase risk of specific types of adult psychopathology and physical health outcomes (Eilers et al., 2022; Harms et al., 2019; Waxman et al., 2014).

CM is thought to disrupt emotional development and functioning (Young et al., 2014), although research examining emotion functioning of CM survivors in daily life is scarce. Victims of prolonged interpersonal trauma early in the life cycle show an increased risk of problems with affect and impulse regulation, memory, attention, self-perception, interpersonal relations, somatization, and systems of meaning (van der Kolk et al., 2005). However, little is known about potential differential associations between the type of CM and emotion functioning in daily life. In this study, we therefore explore how different types of abuse and neglect are associated with five key parameters of emotional change in daily life, or emotional dynamics; namely, emotional intensity, variability, instability, inertia, and diversity, as outlined in Table 2.
A deeper understanding of differential CM effects on adult emotion dynamics may inform theories on the ontogenesis and function of emotions and can help to identify what is well-adjusted and dysfunctional emotional development (e.g., Cicchetti & Ng, 2014). CM effects on emotion dynamics may also help us to better understand the characteristics of “healthy emotional functioning” that underlies the mental and physical health and resilience that most people show against, or despite, psychopathology and major adversity (American Psychiatric Association, 2022; Bonanno et al., 2004). By doing so, we hope that this study strengthens the emerging literature on differences between CM types (next to CM severity) to bolster the promise to tailor interventions and help foster resilience and positive outcomes (see Masten et al., 2021; Orbke & Smith, 2012).

Before we present our model and study results, we first introduce the different CM types, our conceptualization of five emotion dynamics, and what is known about their connections, and conclude with a synthesis and discussion of the results.

**Childhood maltreatment and developmental outcomes**

CM severity and specific types of abuse (emotional, physical, sexual) and neglect (emotional/physical) have been associated with a range of outcomes, such as fewer and less intense positive emotions, and more frequent and intense negative emotions (Infurna et al., 2015; Lavi et al., 2019; Turiano et al., 2017). The differences in frequency and arousal of emotions that are seen in CM survivors are in keeping with a “better safe than sorry” or conservative behavioral strategy (Nesse, 2019; Van den Bergh et al., 2021), in which frequent negative emotions indicate alarm, whereas positive emotions signal exploration and downregulation of sympathetic arousal, as elaborated upon in the method section. In terms of mental health, CM predicts both internalizing and externalizing symptoms in later life (Spinhoven et al., 2016; Waxman et al., 2014). Associations between specific CM types and outcomes have also been found, as emotional neglect and abuse seem to convey a specific heightened risk of developing anxiety and depression (Kuzminskaite et al., 2021), while emotional neglect in specific predicts the development of avoidant and schizoid personality disorders (Waxman et al., 2014), among others.

The typical explanation for the downstream risk of CM on emotions, physical, and mental health and well-being is a hypothalamic–pituitary–adrenal (HPA)-axis dysregulation and subsequent hormone secretion and wear-and-tear on the body, called “allostatic load” (see Kuzminskaite et al., 2021; Schenk et al., 2018; van der Kolk, 2014). CM may also distort children's awareness of and sensitivity to internal bodily states – called interoception – which
are essential for adaptive psychological functioning and development (Khalsa et al., 2018; Murphy et al., 2017). Additionally, specific CM types are associated with specific clusters of physical symptoms (Eilers et al., 2022), and there is also evidence of specificity from brain functioning studies (Cassiers et al., 2018). CM types evidently have unique sequela in terms of mental and physical health and well-being, neuroanatomical organization, and differences in one’s emotional landscape and behavioral repertoire.

**Maltreatment and emotional functioning across the lifespan**

CM can have far-reaching consequences for children's emotional well-being and development. For example, it can affect the intensity and variability with which CM survivors experience certain emotions, as well the perception, recognition (e.g., alexithymia), understanding, expression, regulation, categorization and/or diversity of the emotion concepts used (Cicchetti & Ng, 2014; Cicchetti & Toth, 2015; Harms et al., 2019). From the perspective of constructed emotion theory, person and event constitute an indissociable whole, because emotions serve to establish, maintain, change, or terminate the relation between the person and the environment on matters of significance to personal goals (Barrett, 2017). Personal goals may connect to past (CM) experiences, such as a stronger need for safety, physical integrity, or autonomy (Campos et al., 1994). Different CM experiences might instigate the development of different adaptation strategies and patterns of emotional functioning.

Acts of omission, for example, essentially an environment of neglect that deprives a child from a basic human need, is a profoundly different experience than acts of commission, such as abuse, that threaten a child’s safety. Minimal scaffolding and interactions with caregivers may lead to a limited development of complex cognitive and emotion functioning in neglected children (Lambert et al., 2017; Machlin et al., 2019). On the other hand, acts of commission may alter cognitive processes related to fear learning and reactivity to negative stimuli. Stressful and uncertain environments affect affective information processing and emotion functioning such that individuals are more focused on negative information at the expense of positive information (Zautra et al., 2002). This shrinks people's "affective space" (cf. Davis et al., 2004), in which positive and negative emotions show a more bipolar relationship.

Differential imprints of some CM types on emotional development have been observed in children as early as 3 months of age onwards (Cicchetti & Ng, 2014; Cicchetti & Toth, 2015). Neglected children have been observed to show attenuated emotional
experiences or “flat affect”, for example, and more difficulties in emotional expression recognition, whereas physically abused children show a sensitivity bias in response to the perception of anger (Cicchetti & Toth, 2015). Physical and sexual abuse and physical neglect are associated with emotional dysregulation, but emotional maltreatment is not (Kim & Cicchetti, 2010). Emotional delays and scars are most prominent in children but may get "under the skin" over adolescence and adulthood (Luke & Banerjee, 2013) which may result in different emotion dynamic patterns even later in life. However, older generations are both more likely to have experienced childhood neglect (e.g., Bullinger et al., 2020) and to have more positively tuned emotion systems (Carstensen et al., 2011; Riediger & Rauers, 2014), including reduced negative affect, which may also influence the observed associations between CM and emotional functioning.

Hitherto the differential impact of commonly studied CM types (as conceptualized by Bernstein et al., 2003) on adult emotional functioning remains understudied, and different objective and subjective features of CM may shape the functioning of emotions accordingly, see Table 1. However, the heterogeneity in the definition of CM types across studies can also result in differences in how CM types associate with adult emotional functioning. Different maltreatment types additionally have characteristics in common, which may obfuscate their independent (“unique”) associations with emotion dynamics when this is not adjusted for (Green et al., 2010; Scott et al., 2010). Fortunately, these unique associations can be estimated in statistical models with mutual adjustment, which may help identify specific mechanisms (see Table 1)
<table>
<thead>
<tr>
<th>Total CM</th>
<th>Abuse</th>
<th>Neglect</th>
<th>Sexual Abuse</th>
<th>Physical abuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM</td>
<td>PA and/or SA and/or EA combined. Prime examples are verbal abuse, humiliation, and acts that scare or terrorize a child.</td>
<td>PN and EN combined, primarily inadequate health care, supervision, and protection from hazards, and deprivation of basic needs (clothing/food) and inattiveness to a child's emotional and development needs.</td>
<td>Unwanted and/or coercive (attempted) sexual contact and exposure to age-inappropriate sexual material or environments, or sexual exploitation. A dependent, developmentally immature child/adolescent is exposed to sexual activities which they do not fully comprehend, for which they are unable to give consent, and/or that violate the social taboos or family roles.</td>
<td>Actual or attempted infliction of physical pain with or without use of an object or weapon and including use of severe corporal punishment. Examples include beating, shaking, choking, slapping, biting, and throwing objects.</td>
</tr>
<tr>
<td>PA</td>
<td>--</td>
<td>++</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>NA</td>
<td>a,i,k</td>
<td>i,k</td>
<td>b, n</td>
<td>d</td>
</tr>
<tr>
<td>Emotion Dynamics</td>
<td>Higher variability of PA and NA</td>
<td>Higher NA intensity after daily stress.</td>
<td>Lower sensitivity to affect words.</td>
<td>Impulse control.</td>
</tr>
<tr>
<td>Category</td>
<td>Acronym</td>
<td>Description</td>
<td>References</td>
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<tr>
<td>-----------------------</td>
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<td></td>
</tr>
<tr>
<td>Emotional Abuse</td>
<td>EA</td>
<td>Acts of commission against a minor child (other than SA/PA) that caused or could have caused conduct, cognitive, affective or other mental disturbance, such as verbal abuse, emotional abuse, excessive demands on a child's performance that may lead to negative self-image and disturbed behavior. Examples include disregard for a child's requests or needs and manipulation of emotions, e.g., withholding affection, intimidation/threats, or gaslighting.</td>
<td>a–h*</td>
<td></td>
</tr>
<tr>
<td>Physical Neglect</td>
<td>PN</td>
<td>Failure to provide for a child's basic survival needs, such as nutrition, clothing, shelter, hygiene, and medical care (e.g., caries). Physical neglect may also involve inadequate supervision of a child and other forms of reckless disregard of the child's safety and welfare, such as seeking needed medical care (e.g., untreated wounds or bones).</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>Emotional Neglect</td>
<td>NA</td>
<td>Acts of omission against a minor child that caused or could have caused conduct, cognitive, affective or other mental disturbance, such as emotional neglect or intentional social deprivation. One example is failure of parents to arrange appropriate education or knowingly permitting maladaptive behavior.</td>
<td>i–k*</td>
<td></td>
</tr>
</tbody>
</table>

Emotion dynamics

Five of the most commonly studied measures of emotion dynamics are emotion intensity, variability, instability, inertia and emodiversity patterns (Dejonckheere et al., 2019; Houben et al., 2015; Kuppens et al., 2017), which are defined in Table 2, where also prominent associations with various mental health indices are shown. These five measures of emotion dynamics cover the intensity and fluctuation patterns of emotions. Additionally, emotions can be categorized according to their positive or negative valence (“affect color” i.e., PA/NA) and arousal or bodily activation, following the structure of the affect circumplex (Russell, 1980; Yik et al., 1999), as illustrated in Figure 1.

Figure 1.
Circumplex model of positive and negative affect (PA/NA) adapted from Russell (1980) and Yik et al. (1999) containing the 12 emotions under study.

Functionally, emotional functioning serves as a system designed to identify and handle information that is essential for an individual's goals and well-being (Barrett, 2018; Frijda, 2007). Therefore, emotional change or emotion dynamics are central to healthy functioning of emotions (Kuppens et al., 2017). From an evolutionary standpoint, negative

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1 Extensive reviews of associations between emotion dynamics and mental health are given elsewhere by Houben et al. (2015), Kuppens et al. (2017), and Reitsema et al. (2022a).
emotions have an alarm function, and signal one’s welfare is threatened (“avoidance/defend”), whereas positive emotions signal safety, which in turn allows people to invest in growth and play (“approach”), and prepare for a wider range of potential futures (Rozin & Royzman, 2001; Tugade, 2010). A reduction in NA does not necessarily lead to improvements in PA, as positive and negative affect can change independently of each other, depending on stress levels (i.e., affect is more bipolar during stress, Ong et al., 2006; Zautra et al., 2002, 2005). This implies that risk/protective factors can have different effects on NA compared to PA. Furthermore, with age, most people tend to increase in mean intensity PA and decrease in their mean intensity NA, a negativity bias in youth that fades with age (Carstensen et al., 2011), especially in more aroused emotions; but whether and how emotion dynamics vary with age is less clear (Reitsema et al., 2022a).

Through emotion socialization (e.g., Eisenberg et al., 1998), children acquire the emotional repertoire and flexibility that they need to adjust to environmental demands and achieve personal goals (Barrett, 2018; Tamir et al., 2020). CM threatens the optimal development of these processes. Arousal is not only costly at the physiological level, it also reduces one’s sensitivity to other relevant environmental stimuli (Lyubomirsky, 2011), and high intensity (aroused) emotions should therefore be regulated down (“hedonic adaptation”) to allow the mind to shift to contextual novelty and change (Reitsema et al., 2022b). Functionally, an optimal emotional response lies in the middle of a hypothetical continuum that runs from being insensitive or “rigid” (emotional inertia) to being “flexible” or “overwhelmed” (emotional instability), see Bos et al., (2019), Bosley et al. (2019) and Reitsema et al. (2022c). A practical example is that the frequency of conflicts between adolescents and their parents increases as a result of adolescents showing either very low or high emotional variability (see Lichtwarck-Aschoff et al., 2009).

Emotional inflexibility can be expressed through high inertia whereas emotional variability may capture differential sensitivity to environmental cues (see Table 2), and both low and high sensitivity and high inertia have been considered to reflect disruptive emotion fluctuations (Kuppens & Verduyn, 2015). High emotion intensity can also indicate disruptive or inflexible emotional functioning, as many mental problems pertain to a system that is unable to reduce negative emotions. Adaptive patterns of emotion functioning have been characterized by low emotion intensity, low variability, instability, and inertia of both positive and negative affect (Ernst et al., 2020; Gruber et al., 2013; Houben et al., 2015). Emodiversity can also inform on (mal-)adaptive, flexible mental states, since experiencing a wider range of emotions can signal more conceptual knowledge (Barrett, 2018), which may
result in better adjustment to environmental changes. In this paper we zoom in on the link between CM types and the most commonly studied emotion dynamics.

Table 2.
Overview of emotion dynamic of interest in this study and associated mental health states.

<table>
<thead>
<tr>
<th>Emotion Dynamic</th>
<th>Definition and Operationalization</th>
<th>Mental health associations in adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intensity</strong></td>
<td>Baseline, average intensity Average (M)</td>
<td>NA+ with internalizing disorder Dx.(^g)</td>
</tr>
<tr>
<td><strong>Variability</strong></td>
<td>Range of fluctuations Standard deviation (SD) or variance</td>
<td>NA+ with depression (D(_x))(^b), bipolar spectrum D(_x)(^c), PA- with depression D(_x)(^b), with internalizing disorder D(_x)(^g) and eudaimonic well-being(^b)</td>
</tr>
<tr>
<td><strong>Instability</strong></td>
<td>The square root of the mean squared successive difference (rMSSD) measures both variability (magnitude of fluctuations) and temporal dependency as average change in emotional intensity between two successive measurement occasions.</td>
<td>NA+ and PA+ associate with current anxiety Dx.(^a), depression D(_x), and NA+ with bipolar spectrum D(_x)(^c) and hypomanic personality;(^c) NA- was associated with eudaimonic well-being,(^b) PA/NA, and life satisfaction.(^b)</td>
</tr>
<tr>
<td><strong>Inertia</strong></td>
<td>The autocorrelation quantifies emotional persistence which may capture inflexibility.</td>
<td>NA+ and PA+ associate with depression D(_x)(^d) and PA with hyperthymic temperament(^e)*, PA+ externalizing disorder D(_x)(^g), NA- associates with satisfaction with life,(^b) PA/NA eudaimonic well-being.(^b)</td>
</tr>
<tr>
<td><strong>Emodiversity</strong></td>
<td>Variety of one’s emotional repertoire. Gini coefficient: the weighted sum of the frequencies of various same-valence emotions divided by the product of the total frequency of all same valence emotions, and the total number of emotion categories.</td>
<td>NA+/PA+ is protective against depression S(_x)(^e), NA+ more anxiety/depression S(_x)(^f)</td>
</tr>
</tbody>
</table>

Note. PA = Positive Affect. NA = Negative Affect. D\(_x\) = diagnosis. S\(_x\) = symptoms
\(^a\)Schoevers et al. (2021) \(^b\)Houben et al. (2015), \(^c\)Sperry et al. (2020), \(^d\)Kuppens et al. (2010), \(^e\)Quoidbach et al. (2014), \(^f\)Urban-Wojcik et al. (2022), \(^g\)Scott et al. (2020).
\(^*\) Hyperthymic temperament refers to low-grade mania.
This study

Despite a booming emotion literature, our understanding of how specific CM histories shape emotion landscapes and dynamics remains largely uncharted territory (see overview in Table 1). Consequences of CM on emotional experiences is studied mostly through cross-sectional and experimental studies, and most previous work on emotion fluctuations pertained to emotional reactivity to stressors or positive experiences (Glaser et al., 2006; Infurna et al., 2015). The present study aimed to examine the downstream consequences of CM on five emotion dynamic measures that play a key role in mental health and well-being in youth (Reitsema et al., 2022a) and adults (Houben et al., 2015; Kuppens et al., 2017), namely, the intensity, variability, instability, inertia, and diversity of positive and negative emotions (see Table 2). We expect significant association between the five CM types and five emotion dynamic measures. Our measurement model was statistically adjusted for all other CM types to identify each unique association with differences in adult emotional functioning.

Method

Participants

Data were derived from 14,418 participants of the “HowNutsAreTheDutch” crowdsourcing study of the general population (HND, van der Krieke et al., 2016), from which 456 participants were selected, who both completed a 30-days diary study and Childhood Trauma Questionnaire (CTQ, Thombs et al., 2009). Participants who had not completed at least 65% (58/90) of measurements (n = 166) were also excluded from the main analyses. Other requirements for participation included to be aged 18 or older, have a phone with an internet connection, and not to be engaged in daily routine disruptions (e.g., shift work, planned trips) during the 30 days study period. Before enrolling, participants had to approve that their anonymised data be used in scientific research. The inclusion criteria resulted in a final sample (n = 290, 64%) with an age range from 19-73 and mean age of 41.2 years (standard deviation (SD) of 13.5). In comparison with the general HND pool of participants, our sample comprised more women (83% vs 65%), and more highly educated (93% vs 75%) and slightly younger participants (mean age 41 versus 45).

Procedure

The diary data collection launched in the Netherlands on the 22nd of May 2013 through an online platform (https://www.hoegekis.nl/) as an extension of the cross-sectional
study started in December 2013 (for the detailed procedure see van der Krieke et al., 2016). Participants were invited through different media such as radio, television, newspapers, magazines, social media, etc. We selected participants who participated in both the cross-sectional and 30-days diary study. In the cross sectional study, after completing four mandatory modules (“start”, living situation, affect/mood, and well-being), participants could choose to complete the childhood trauma (CTQ) questionnaire ($n = 1595$). Diary study participants had to complete a block of questions regarding their mood and daily life activities three times per day (maximum of 90 assessments) with a six-hour interval and on the exact time point schedule, which they could choose at the beginning of the enrolment (e.g., 9:00 am, 3:00 pm and 9:00 pm). After receiving a text message, they had to complete questions within one hour after the invitation. All the data were extracted on the 19th of December 2018. The study was approved by the Medical Ethical Committee of the University Medical Center Groningen (registration number: M13.147422 and M14.160855).

Measures

**Emotion dynamics.** All the emotion dynamic measures were calculated per participant based on 12 momentary emotional items selected based on the circumplex model of affect, which distinguishes emotions according to the valence and arousal/activation dimensions of affect (Barrett & Russell, 1999; Yik et al., 1999). Activated positive affect (PAA) was measured with feeling energetic, enthusiastic, or cheerful. Deactivated positive affect (PAD) was measured with the emotions relaxed, calm, and content. Activated negative affect (NAA) was measured with the emotions anxious, nervous, and irritable. Deactivated negative affect (NAD) combines the emotions gloomy, dull, and tired. Consequently, the PAA variable reflects the mean of feeling energetic, enthusiastic, and cheerful per assessment on a slider scale ranging from “Not at all” (0) to “Very much” (100). Similarly, the NAD variable reflects the mean of feeling gloomy/ dull/ tired per assessment on a slider scale ranging from “Not at all” (0) to “Very much” (100).

For each person, a set of summary statistics of the most popular dynamic measures *intensity (mean), variability (SD), instability (square root of the mean squared successive difference, rMSSD), and inertia (autocorrelation)* was calculated separately for four composite affect measures (PAA, PAD, NAA, NAD), across all 90 measurement occasions. For the main analyses, the missing values were omitted, and emotion dynamic measures summarized all available data. For the sensitivity analyses, missing values were imputed. Autocorrelation was defined as the correlation of the original variable (e.g., PAD) with the
lagged score of the same variable (1 lag-PAD). Emodiversity scores are typically operationalized with a Gini ($G$) coefficient that ranges from 0-1 (Benson et al., 2018). The $G$ score was calculated based on the frequency of same valence emotions, over 90 measurement occasions, where the intensity of the emotions was rated above 10 on the scale 0-100, following the example of Dejonckheere et al. (2019). The cut-off point of $\geq 10/100$ was chosen because the values 0-9 could be unintentionally marked when moving the slider down to 0 (on a 0-100 scale).

**Childhood Maltreatment.** Childhood maltreatment was measured with a retrospective self-report Dutch version of the short form of the Childhood Trauma Questionnaire (CTQ-SF, Bernstein et al., 2003; Thombs et al., 2009). The CTQ measures types of abuse and neglect that are reflected in the WHO's (2006) definition of child maltreatment, and the CTQ is widely used in research (Viola et al., 2016). The instrument consists of 24 items that distinguish three types of abuse: physical (e.g., I was punished with a belt, a board, a cord (or some other hard objects); emotional (e.g., People in my family called me things like “stupid”, “lazy” or “ugly”); and sexual (e.g., Someone tried to touch me in a sexual way or tried to make me touch them). And two types of neglect: physical (e.g., I didn’t have enough to eat); and emotional (e.g., I thought that my parents wished I had never been born). Items are scored on a 5-point Likert scale (1 = never true, 2 = rarely true, 3 = sometimes true, 4 = often true, 5 = very often true). In the Dutch version, one item for sexual abuse was omitted (“I believe I was molested”) because of translational non-equivalence (Thombs et al., 2009). In our sample, the overall trauma scale showed good reliability (Cronbach’s $\alpha = .91$) as well as the subscales for Physical Abuse (.81), Emotional Abuse (.85), Sexual Abuse (.93), Emotional Neglect (.85). However, the reliability score for Physical Neglect was moderate (.57), which has previously been reported in community samples (Hagborg et al., 2022; Scher et al., 2001; Thombs et al., 2009).

**Statistical procedures**

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2 The values of $G$ coefficient are on a scale 0-1 where low numbers imply high diversity. For the simplicity of interpretation we inverted it via $1-G$ where high coefficients would denote high emodiversity.
All the analyses were performed using R (R Core Team, 2021) and were pre-registered (osf.io/4jbcy). The distribution of childhood maltreatment (see Table 3; Figure 2A) was marked by high skewness and kurtosis. Among the emotion dynamic indices, positive emodiversity was highly kurtotic (see Supplementary Figure S1). Due to the non-normality of the data we used Spearman correlations (Schober et al., 2018) to assess the associations between maltreatment types and CTQ score, and non-parametric tests for group comparisons (i.e., bootstrap). In the calculation of emotion dynamics, we first excluded missing values, after which we repeated the analysis using an imputed dataset to check for robustness. The final data structure did not hold missing values since emotion dynamics were calculated for each participant, and all participants completed the maltreatment (CTQ) questionnaire. The variance inflation factors for each type of maltreatment ranged from 1.38 to 3.31, all far below the tolerance cut-off of 5 for multicollinearity (James et al., 2013).

To examine the associations between five types of maltreatment as predictors and 18 emotion dynamics as an outcome, we used Structural Equation Modeling (SEM), estimated using the lavaan package (Rosseel, 2012). To account for normality violations in the data, a robust maximum likelihood estimator (MLM in lavaan) was used to fit our SEM models. MLM provides the Satorra-Bentler scaling correction for $\chi^2$, robust SE and other corrected fit indices (Root Mean Square Error of Approximation (RMSEA) and the Bentler Comparative Fit Index (CFI)). A stepwise backward selection procedure was used to reduce an unrestricted SEM model in which all paths between the 18 emotion dynamics and five types of maltreatment were estimated, to derive the most parsimonious final model (see Table 5).

Nested models were compared using the Satorra-Bentler corrected $\Delta \chi^2$ difference test, until a most restricted “Final model” was selected for which the $\Delta \chi^2$ difference test was below $p < .05$; (all model selection details are provided in Supplementary Table S1). The goodness of fit of the final model was assessed based on cut-off values of four criteria recommended by Kline (2016): $\chi^2$ test statistics ($df$) and $p$ value, RMSEA ($< .08$), Standardized Root Mean Squared Residual (SRMR $< .10$) and CFI ($> .95$). A posteriori power analysis was calculated for the final SEM model with SemPower package (Jobst et al., 2021) and based on obtained sample size, $df$, RMSEA and alpha, a power of .93 was achieved for our SEM model. Note that the power to reliably detect each specific path in the SEM model may be lower.

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3 Pre-registered moderation effect analysis of social contact frequency was originally planned, but given small power for reporting reliable estimates we refrained from reporting the results. Available on request.
For the robustness analyses, we imputed missing values for each participant’s time series with the imputeTS package (Moritz & Bartz-Beielstein, 2017). Moving average mean level method was used, with one window observation, meaning mean values were computed based on one prior and posterior observation for every missing value. When two or more consecutive observations were missing, the closest previous and posterior observations were used. The Final SEM model and interaction effects were estimated with imputed dataset.

**Effect sizes**

Three effect size indices are common to express results in psychology: correlations (r), Cohen’s d, and partial regression coefficients (β). We classified correlations (r) and beta’s (β) as small if they were between 0.10 and 0.19, moderate between 0.20 and 0.29, and large from 0.30, based on effect sizes commonly found in social psychology (Peterson & Brown, 2005; Richard et al., 2003). For an effect size of around r = .20 (the average effect in personality and social psychology over the past century, Richard et al., 2003), studies need at least 150 participants, and ideally up to 250 participants are needed to reduce estimation error in correlations (Schönbrodt & Perugini, 2013).

**Results**

**Sample description**

In our sample, 36% (N = 166) did not complete the minimally required 58 diary assessments, and were excluded from the analyses. Group comparisons showed no salient differences between the 290 included participants who completed at least 65% of the diary assessments and the 166 who did not in terms of age (t(454)= -1.22, p = .36), gender (χ²(1)= 0.81, p = .37), or education level (χ²(7)= 10.25, p = .17), and neither in the pre-diary measure of positive affect (t(443)= -1.66, p = .06), or overall maltreatment (CTQ) scores (t(454) = 1.88, p = .30). Excluded participants reported slightly more pre-diary negative affect (t(443) = 1.89, p = .02).
Figure 2A.

*CTQ Scores distribution across maltreatment types*

![CTQ Scores distribution across maltreatment types](image)

*Note.* EA= Emotional Abuse. EN= Emotional Neglect. PA= Physical Abuse. PN= Physical Neglect. SA= Sexual Abuse. CTQ= Childhood Trauma Questionnaire.

Figure 2B.

*The prevalence of the five types of child abuse and neglect in our sample*

![The prevalence of the five types of child abuse and neglect in our sample](image)
We checked for outliers (participants who never scored above 0 on any of the emotion items), but none were identified. The distribution of positive affect emodiversity indicated high kurtosis, and most of the maltreatment types showed deviations from normality (see Figure 2A and Table 3).

Table 3

**Descriptive statistics**

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*Note.* PAA = Positive Affect Activation. PAD = Positive Affect Deactivation. NAA = Negative Affect Activation. NAD = Negative Affect Deactivation. Variables were considered to be non-normally distributed at skewness scores > 2 and kurtosis > 7 (West et al., 1995), and these estimates are depicted in bold.
The bivariate correlations between maltreatment types, emotion dynamic measures, age, gender, and education are presented in Table 4. Older and lower educated participants reported more CM, especially more neglect and emotional abuse. Older adults also reported more intense positive affect and less intense negative affect as well as more stable emotions and less diverse negative emotions (see Table 4). None of the emotion dynamic measures correlated significantly with education. The correlations between different CM types illustrate the common co-occurrence of different trauma types, such as physical- and emotional abuse ($r = .48$), and emotional abuse and neglect ($r = .64$). The co-occurrence of sexual abuse and physical neglect was least likely ($r = .18$). Finally, emotional abuse ($r = .82$) and neglect ($r = .90$) were the best indicators of “general CM” (total CTQ scores, see Table 4 and Figure 2A).

More childhood maltreatment (expressed as total CTQ score) was associated with various emotion dynamic measures, positively with NAA/NAD intensity and negatively with PAA/PAD intensity. Childhood maltreatment associated with aroused negative affect (NAA) variability and instability, but not with the other dynamic measures. Maltreatment was also associated with a broader range and higher frequency of negative affect indicators (emodiversity), suggesting more frequent and diverse negative emotions. These effect sizes were all small in magnitude. These data suggest that overall, CM showed stronger associations with adult negative than positive emotions.
### Table 4

**Spearman correlation between model variables**

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<sup>Note</sup>. Correlations ≥ .12 significant at p < .05, ≥ .15 at p < .01, and ≥ .22 at p < .001. All significant correlations are shown in bold. PA= Physical Abuse. EA= Emotional Abuse. SA= Sexual Abuse. PN= Physical Neglect. EN= Emotional Neglect. PAA= Positive Affect Activation. PAD= Positive Affect Deactivation. NAA= Negative Affect Activation. NAD= Negative Affect Deactivation. <sup>a</sup> Gender coded as 0 = woman, 1 = man, which means negative values for the man group. <sup>b</sup> Educational level ranged from 1 (elementary school not finished) to 8 (academic degree).

### Childhood maltreatment and emotion dynamics

The most unrestricted model estimating all possible associations between five maltreatment types and 18 emotion dynamics comprised 68 associations (“paths”) that could be removed without worsening the model fit (see Supplementary Table S1 for step-by-step details). Fit indices of the Final model indicated a good statistical fit to the data ($\chi^2 = 49.94$, $df = 68$, $p = .95$; with CFI = 1, RMSEA = 0.00 [95% CI = 0.00, 0.00]), SRMR = 0.04). Some emotion dynamic measures (inertia and emodiversity) had low variances (e.g., 0.03), which
could potentially have hampered the estimation of associations between specific maltreatment
types and these variables.

The path coefficients of all significant associations are presented in Table 5. In the
Final model, four types of abuse uniquely predicted 15 emotion dynamic measures with little
overlap in pattern of emotional experiences. Physical abuse was not associated with any adult
emotion dynamic measures. Below, we describe how five types of maltreatment differentially
associate with the five studied emotion dynamic indices.

The Final model shows how abuse and neglect could be differentiated by their
positive versus negative associations with the five emotion dynamic measures, which might
suggest that acts of commission strengthen whereas omissions weaken the dynamics and
impact of emotional experiences. These results also suggest that emotional valence associated
with distinct types of maltreatment. Emotional neglect is primarily associated with dynamics
of positive emotions (lower intensity, variability and instability of PAA/PAD), while
associations with negative emotion dynamics were rare (exceptions were inertia and
variability of NAA). Sexual abuse also associated with more instable PAD ($\beta = 0.04$) and less
inert PAD ($\beta = -0.09$), however, these effects were small in magnitude.

Other types of abuse and neglect associated mostly with dynamics of negative
emotions. The strongest association was between emotional abuse and intensity of negative
affect and negative affect emodiversity. Interestingly, childhood physical neglect and sexual
abuse both predicted negative affect variability (NAA/NAD) and instability (NAA/NAD),
but in the opposite direction (sexual abuse increasing and physical neglect decreasing trends).
We also observed unexpected associations between physical neglect and higher intensity
levels of PAD (content, calm, relaxed).
Table 5.

Table present standardized ($\beta$) regression coefficients between emotion dynamics and maltreatment types

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<tr>
<td>NAA</td>
<td>.11** (.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emodiversity</td>
<td>Negative affect</td>
<td>.17** (.05)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. PAA = Positive Affect Activation. PAD = Positive Affect Deactivation. NAA = Negative Affect Activation. NAD = Negative Affect Deactivation. Note that positive affect emodiversity and inertia PAA/NAD were unrelated and therefore not part of the Final model. Significant at $p < .05$, $p < .01$, $p < .001$

Sensitivity analyses

The final SEM model was fit to the imputed dataset, as outlined in the statistical procedure section. The model fit indices showed equally good statistical fit to the data than for our unimputed model ($\chi^2 = 52.86$, $df = 68$, $p = .91$; with CFI = 1, RMSEA = 0.00 [95% CI = 0.00, 0.02]), SRMR = 0.05). The standardised $\beta$ coefficients changed slightly for the majority of the paths. The most prominent changes were observed in the association between physical neglect and variability NAA that disappeared, while associations between sexual abuse and the instability and variability of NAD reached significance at $p < .001$; all model path coefficients are provided in Supplement Table S3.

Post hoc analyses

Because of the high correlations between most of the emotion dynamic measures and age, we examined whether age moderated the effect of CM on emotion dynamics in the Final
model. The model fit indices showed good model fit to the data ($\chi^2 = 106.570$, $df = 121$, $p = .82$; with CFI = 1, RMSEA = 0.00 [95% CI = 0.00, 0.02]), SRMR = 0.05). Only one path was significant, however: among older participants, the effect of sexual abuse on the *inertia* of PAD was lower than among younger participants ($\beta = -0.08$, $p < .05$). This suggests that younger participants with a history of sexual abuse are better able to sustain feelings of relaxation, calmness, and contentness (see Figure 3). All the other moderation effects in the model did not change with age, which suggests that the impact of the abuse/neglect on the emotion dynamics persists over the lifespan.

**Figure 3.**

*The influence of age on the association between sexual abuse and the autocorrelation of unaroused positive affect (PAD). Higher age is represented by one standard deviation (+1SD) above the mean.*

**Discussion**

In this study, we examined and compared the specific association between five childhood maltreatment types and five adult emotion dynamics patterns over 30 days. First, all emotion dynamics, or whether emotions were *intense, variable, unstable, inert, and diverse*, showed unique associations with childhood maltreatment types. Second, specific maltreatment types were differentially associated with dynamics of positive emotions (emotional neglect) and negative emotions (emotional/sexual abuse and physical neglect), or were not associated with any emotion dynamics (physical abuse). Third, our results showed a salient distinction between abuse and neglect (acts of commission and omission) in their associations with emotion dynamic patterns, specifically in intensity, variability and
instability. Fourth, the effects of CM on emotion dynamics were long-lasting, and we may have observed generational differences in CM prevalence and emotion dynamics. These four key observations are discussed in detail below.

**Neglect versus Abuse**

Our final model showed salient differences between the effects of abuse and neglect on emotion dynamics. Although abuse was associated with higher intensity, variability, and instability of negative emotions (NAA/NAD), the opposite pattern was true for neglect (i.e., lower intensity, variability, and instability). Several behavioral experimental studies have reported that abuse is associated with higher intensity of positive but lower intensity of negative emotions in response to attractive/adverse pictures (Wooten et al., 2022). However, results from such studies are difficult to compare with those from studies that assess emotions in daily life, such as the current study, which is also a key argument for momentary assessment/experience sampling studies (van der Krieke et al., 2016).

Researchers have suggested that deprivation (neglect) and threat (abuse) have distinct consequences on children's cognitive and emotional development (Lambert et al., 2017; Machlin et al., 2019). Specifically, maltreatment involving abuse may sensitize cognitive and emotional processes involved in fear learning and reactivity to negative stimuli, which would be adaptive in stressful environments. This could result in heightened variability and instability of negative emotions as observed in our study. This is also in line with studies showing a link between abuse and impulse control difficulties (Oshri et al., 2015). On the other hand, neglected children might be deprived of sufficient opportunities to develop adaptive emotion functioning, which could lead to reduced sensitivity to negative emotional stimuli, thereby reducing the variability and instability of negative emotions.

Our results also align with the associations between neglect and attenuated emotional experiences in children (Cicchetti & Toth, 2015) and lower emotional knowledge and understanding (Shipman et al., 2005). Scaffolding and interactions with caregivers are necessary to develop emotion understanding and regulation skills. Children deprived of such opportunities, as in the case of neglect, have been found to have problems with emotion understanding. Specifically, neglect was found to be associated with difficulties in recognizing (positive) facial expressions (Doretto & Scivoletto, 2018; Young & Widom, 2014), lower sensitivity to affective words (Warmingham et al., 2022), and lack of emotional awareness and emotion clarity (Berzenski, 2019), although not in all studies (Wooten et al.,
One would expect that neglect would also be associated with lower emodiversity, as the ability to experience a wide range of emotions depends on having knowledge of these concepts in the first place. However, our results did not reveal a link between neglect and emodiversity. This might be partly due to the operationalization of this concept, which we will discuss in the limitations section.

The reviewed literature and our results suggest that abuse and neglect may elicit different sequelae, including how emotions are experienced and regulated. One could speculate that neglect flattens emotion dynamics (e.g., higher inertia), as one has learned to become emotionally unresponsive to specific contextual information, and endures/ignores the associated and familiar negative emotions. There is an established connection between neglect and "flat [blunted] affect" in children once their needs are consistently disregarded, ignored, invalidated, or unappreciated, and the child goes into “I'm on my own” modus and becomes emotionally disconnected (see Ludwig & Rostain, 2009). This is a common intergenerational loop (e.g., Greene et al., 2020; Osborne et al., 2021), and flattened affect has also been reported in the context of overabundant wealth, when the family does not meet a child's emotional or safety needs (Ludwig & Rostain, 2009).

Subtypes

Physical Abuse

Although individual differences play a significant role, it seems that physical abuse had the smallest impact on adult emotional functioning (see Table 4), and was therefore removed from our model (Table 5). Physical abuse is one of the most salient and openly aggressive forms of maltreatment, with numerous sequelae in childhood and/or adolescence (Institute of Medicine & National Research Council, 2014; Krugman & Korbin, 2022), although the evidence for a negative impact on adult mental health is inconclusive (Carr et al., 2013; Kong et al., 2018; Spinhoven et al., 2010; Spinhoven et al., 2016; Volgenau et al., 2022). Previous studies did not always account for other types of maltreatment when assessing the consequences of physical abuse, although in studies that controlled for other types of CM, physical abuse was no longer associated with emotional (dys-)regulation (Burns et al., 2010; Oshri et al., 2015). One plausible explanation for this lack of association is that the relative visibility of physical abuse is more likely to result in help or support than the other CM types that we distinguished.

Another possibility is that physical abuse survivors are the most resilient. Child physical abuse has been found to be associated with an array of positive adult outcomes, such
as higher positive and lower negative affect and depression, more happiness, self-acceptance, and personal autonomy (Jeronimus et al., 2022). Previously, we argued that once children become adults, and feel that they no longer can be physically hurt, they may feel that their future is unlikely to be as bad as their past has been (a sense of control), which may result in some positive growth.

An alternative explanation for the lack of association between physical abuse and emotion dynamics is that most of the individuals in our sample reported low levels of physical abuse severity (see Figure 2B), resulting in lower statistical power for detecting specific associations with emotion dynamics. Previous work has reported poor emotion regulation in children exposed to physical abuse, resulting in more aggressive and disruptive behavior (Teisl & Cicchetti, 2008), which could also result in altered emotion dynamics. Future work could therefore focus on evaluating the consequences of physical abuse on adult functioning in more detail, such as dissecting differences in physical abuse frequency and severity, especially in adult general population samples, and ideally in a longitudinal or lifespan study.

**Emotional abuse**

Emotional abuse was found to be associated with fewest emotion dynamics indicators (after physical abuse which showed none), but of all types of abuse, only emotional abuse associated with more intense negative affect, both low and high arousal. Previous research has described such increased mean levels of negative affect as a consequence of CM in general, but in this study we found that this association was unique for emotional abuse. Elevated negative affect intensity levels are often associated with lower well-being and form the core of many psychological disorders (Stanton & Watson, 2014). Therefore, it is important to consider the unique contribution of emotional abuse to elevated levels of negative affect to foster strategies that promote well-being in adults with a history of emotional abuse. This requires us to study the aetiology of such an association in more detail.

Higher levels of emotional abuse were also associated with more negative *emodiversity*: that is, experiencing a wider variety and abundance of negative emotions. It could be possible that experiencing childhood maltreatment in the form of emotional abuse may lead to an emotional processing style that is hyper-responsive to negative emotional stimuli (Günther et al., 2015). This means that the threshold for individuals with a history of emotional abuse to experience negative emotions may be lower. Higher negative affect emodiversity has also been implicated in depression and anxiety (Urban-Wojcik et al., 2022;
Werner-Seidler et al., 2020). There have been some controversies about the measurement of emodiversity and its associations with mental health functioning (Brown & Coyne, 2017), which we discuss in the limitations section.

Emotional abuse has specifically been associated with reduced adult resilience capacity (Nishimi et al., 2020). More research into emotional abuse could strengthen our results, which are not in conflict with studies that have identified emotional abuse as one of the most damaging forms of maltreatment (e.g., Dye, 2020).

**Sexual abuse**

Sexual abuse was primarily associated with negative affect dynamics, namely, higher variability and instability of both high and low arousal (NAA/NAD), although slightly stronger in the higher arousal spectrum. High variability and instability, regardless of valence, is a reflection of low well-being and shared by many psychological disorders (Houben et al., 2015). Studies on emotional functioning have associated sexual abuse with high impulsivity (Oshri et al., 2015), which can reflect an inability to downregulate negative emotions (Houben et al., 2015). These results are in line with the view that forms of childhood abuse lead to a cognitive and emotional processing style adapted for the detection of negative events (see the Neglect vs Abuse section). Higher sexual abuse was also associated with higher PAD instability and inertia, although the effect sizes were much smaller than those for negative affect. Nevertheless, there may be subgroups of individuals for whom there is a stronger association between sexual abuse and PAD dynamics, such as certain age groups (see the moderating effect of age on the relationship between sexual abuse and PAD inertia). This study shows that the unique impact of SA (adjusted for other CM types) is associated with more fluctuating negative emotions.

**Physical Neglect**

Physical neglect was associated with variability and instability of high and low arousal of negative affect (NAA/NAD), similar to sexual abuse, but there were two major differences. First, unlike sexual abuse, physical neglect was associated with reduced fluctuations in negative emotions. Second, unlike sexual abuse, the effect of physical neglect on low arousal (NAD) was slightly stronger than that on high arousal (NAA). These findings once again highlight that there seem to be differences in the consequences of a child being exposed to acts of threat versus deprivation. Lower emotion variability and instability, in general, have been associated with higher levels of well-being, and especially low negative
affect instability with higher eudaimonic well-being (Houben et al., 2015), which, paradoxically, suggests better adaptation in adults with a history of physical neglect. Very low emotion fluctuation could also reflect contextual insensitivity, which is maladaptive in adulthood (Kuppens & Verduyn, 2015). These findings highlight our rudimentary understanding of what makes emotion functioning (mal-)adaptive and stresses the need to study how emotion regulation repertoires can be contextually (mal-)adaptive, as processes that may have been protective in the abusive childhood, can become a source of adult psychopathology.

The contra-intuitive effect of physical neglect on higher mean intensity of PAD can reflect some subgroup differences that were not analysed in this study, and we observed no age effect.

**Emotional neglect**

Emotional neglect is the only type of CM that is predominantly associated with the dynamics of positive emotions, namely the intensity, variability and instability of PAA/PAD. For intensity, the effect was stronger for PAD; however, for variability and instability, the effects were equal across arousal levels. Our results showed that only emotional neglect was associated with lower levels of positive affect, in line with recent findings when other types of CM were controlled for (Volgenau et al., 2022). As opposed to these findings, previous studies also suggested an association between emotional abuse and lower mean levels of positive affect, but always in models that did not account for emotional neglect (Turiano et al., 2017). This underscores the importance of considering all the types of maltreatment when evaluating its consequences, to prevent building a body of knowledge with misleading and contradictory data.

As argued in the previous sections, lower levels of positive affect may reflect reduced sensitivity to the environment. Neglected children may not have had the support and scaffolding that are important to their development of emotional understanding. Additionally, neglect may lead to a hyporesponsive reward system (Mehta et al., 2010), possibly resulting in fewer, less intense, and less variable experiences of positive emotions. Clinical levels of depression have also been associated with lower positive affect variability (Houben et al., 2015), and the inability to experience pleasure (anhedonia) is not only a key symptom of depression, but also connected to emotional maltreatment (Cohen et al., 2019). This is consistent with the observation that association between emotional neglect and negative
emotion functioning were comparatively weak, which indicates that this insensitivity to the environment primarily pertains to positive emotions in our motivational reward systems.

Emotional neglect was also associated with a higher persistence of NAA (inertia), which may signal rigid and maladaptive emotional states, such as low well-being and increased risk of psychopathology (Houben et al., 2015; Kuppens et al., 2010). Inertia may reflect an insensitivity to environmental cues, in line with a hyporesponsive reward system. Additionally, heightened inertia of NAA may also be the consequence of under-developed coping strategies, such as talking to someone to downregulate high arousal negative emotions, which has been found in adults with a history of emotional neglect (Mills et al., 2015).

This maladaptive combination of rigid and persistent negative emotions and low sensitivity to positive emotions (or reward) can be especially harmful, given that emotional neglect is the strongest predictor of adult psychopathology (Simon et al., 2009; Spinhoven et al., 2016). Moreover, deficits in experiences of positive affect, which are important in resilience to stress and adaptation, may constrain a person with a history of emotional neglect in coping with daily stress (Tugade, 2010). Given that emotional neglect has the highest prevalence among all types of maltreatment (see Figure 2B) and because of its impact on adult functioning (Bullinger et al., 2020; Sethi et al., 2013), studies on the mechanisms underlying such adverse consequences are important.

**Emotion dynamics**

Previous studies have suggested that adaptive emotional functioning can be characterized by less variable, less unstable, and less inert emotion dynamics (Gruber et al., 2013; Houben et al., 2015). Such a profile might be found in individuals who are moderately emotionally reactive to events and skilled in downregulating their (intense) negative emotions, which results in fluctuations with less extreme peaks that quickly return to their baseline levels. However, our study showed that it is difficult to make generalizable statements about what constitutes adaptive emotional functioning; in some cases, childhood maltreatment was associated with higher emotional variability and instability (sexual and emotional abuse) and in other cases with lower emotional variability and instability (physical and emotional neglect).

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4 Given the weak effect size of NAA variability this result was not interpreted in the discussion.
Moreover, these patterns of emotional fluctuations can be argued to represent an adaptive pattern to the environment in which these individuals grew up. Individuals who were as children exposed to threatening environments (in the case of abuse) show an emotion dynamic pattern characterized by heightened sensitivity to negative emotional events, resulting in higher ups and downs of negative emotions and experiencing a wider variety of negative emotions in their daily lives. In contrast, individuals who had been deprived of parental care and socialization show an opposite pattern of heightened unresponsiveness to both negative events and positive, rewarding events, resulting in less fluctuating negative and positive emotions.

These early experiences may also shape the child's environment over time in such a way that patterns of emotional functioning reinforce itself. For example, children exposed to abuse may show an attentional vigilance to threats that increases the likelihood that they will experience threats in the future, and reduces the likelihood of protective experiences and developing and sustaining supportive relationships (McCrory et al., 2015). Experiencing fewer positive emotions may further increase these children's experiences of stress, as positive emotions play a central role in the prevention of adverse physiological effects of stress (Folkman et al., 2000).

**Strengths and limitations**

This paper examined differences in adult emotion dynamics associated with specific CM types, which is new to the literature. The unique associations between adult dynamic indices and specific types of childhood abuse and neglect can offer a window of opportunity to deepen our knowledge on (mal-)adaptive emotion functioning and the common co-occurrence of CM (Vachon et al., 2015). The unique or incremental effects of each maltreatment type on the emotion dynamic indicators was dissected statistically, which allowed us to estimate their differentiating impact on each of the emotion dynamics. Previous research suggested that emotion dynamics might be redundant in predicting psychological functioning and well-being (Dejonckheere, Mestdagh et al., 2019) but in our study we found unique associations between specific dynamic patterns and childhood maltreatment types. This underscores the value of considering multiple emotion dynamic patterns simultaneously. In addition, this is one of the few studies on emotions that categorized affect scores not only by valence (positive/negative) but also along the arousal dimension (low to high), following the emotion circumplex, which helped identify some small but informative differences.
One limitation of our study is that we used broad composite affect scales (PAA/PAD/NAA/NAD) could, which can obscure the existence of different patterns of dynamics of the single emotions that these scales contain (see Ernst et al., 2020; Reitsema et al., 2022c). Another limitation of this work is that the resilience capacity of CM survivors was not taken into account (Cicchetti, 2013), which potentially generates a “noise” in our attempt to isolate the true adverse consequences of specific CM types (Nishimi et al., 2020). For instance, the study of Warmingham et al. (2022) identified six clusters or emotion regulation profiles among emerging adults with CM histories, and two profiles associated with healthy emotional functioning (e.g., characterized by high positive effect and adaptive regulation strategies), and were present in 27% of the sample. Future studies should not ignore the effect of resilience, especially in general population samples.

The present study is also limited by retrospective bias when measuring CM, and particularly in the design, as participants themselves decided to take CTQ survey (see Baldwin et al., 2019). In CM studies, it has been argued that only subjective perceptions of CM relate to downstream negative consequences, as the risk of psychopathology is minimal in individuals who did not report CM, despite being identified as victims of CM in legal cases (Danese & Widom, 2020). Perhaps it is partly the impact of CM on identity formation and the expectation of heightened risk of adverse outcomes that propels aversive outcomes. Moreover, mental symptoms might simply arise from a failure to thrive (Kempe et al., 1962).

The present study examined only linear measures of emotions dynamics, and between CM types and dynamic measures, whereas a broad range of options on nonlinear emotion dynamics could offer a broader view on emotion functioning (Kunnen et al., 2019). Additionally, autocorrelation calculations (emotional inertia) is influenced by the spacing between experience sampling assessments; shorter time intervals yield higher autocorrelations. Given that emotions differ in their duration (Verduyn et al., 2009), we may have failed to capture the lingering effects of some emotions. Finally, the calculation of the emotion dynamic pattern emodiversity suffers from some statistical limitations (Brown et al., 2017). Due to the way it's calculated, the range of possible emodiversity scores is small, which likely reduced the variance in our sample and possibly the power to detect associations with CM in our study. Moreover, the most accurate way to measure the variety of individuals' emotion experiences would be to use an open-ended response format instead of a researcher-determined list of emotion items, although this is more difficult in experience sampling studies and possibly more burdensome for participants.
Finally, a SEM with many variables, such as our unrestricted baseline model, would also benefit from a bigger sample size, however, intensive time series are costly, and our focus on the population of CM survivors reduces the number of eligible participants. Based on our power calculations and model strategy we feel confident about our results but undoubtedly missed the weaker associations that one might also observe in much larger samples.

**Conclusion**

Hitherto most studies on childhood maltreatment and emotions focused on emotion dysregulation and maladaptive coping strategies and differences in emotional processing. In the present study, we expanded this knowledge base (see Table 2) and identified how specific types of child abuse and neglect connect to differences in adult emotion functioning using the five most popular dynamic indices. We observed that physical abuse stood out because no associations with the studied emotion dynamics were observed. Emotional neglect is associated with reduced positive affect and more fixed emotion patterns, whereas physical neglect was associated with reduced negative affect fluctuations. Sexual abuse associated with more variable negative affect and emotional abuse with more intense, diverse, and frequent negative emotions. This study shows that each CM type was connected to different adult emotional experiences, setting the groundwork for further research into how CM types differentially shape adult health and well-being.
References


Hagborg, J. M., Kalin, T., & Gerdner, A. (2022, March 30). The Childhood Trauma Questionnaire—Short Form (CTQ-SF) used with adolescents – methodological report from clinical and community samples. *Journal of Child & Adolescent Trauma*. https://doi.org/10.1007/s40653-022-00443-8


https://www.unicef.org/reports/state-worlds-children-2021


https://doi.org/10.1001/jamapsychiatry.2015.1792


https://doi.org/10.1001/jamapsychiatry.2015.1792


https://doi.org/10.1177/1745691620950690


(HoeGekIsNL): A crowdsourcing study of mental symptoms and strengths.

https://doi.org/10.1002/mpr.1495

Predicting the duration of emotional experience: Two experience sampling studies.

https://doi.org/10.1007/s10578-022-01321-y

https://doi.org/10.1017/s0954579422000025

https://doi.org/10.1002/pmh.1239

https://doi.org/10.1016/j.jad.2020.04.060


