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Review article

Association between childhood maltreatment and callous-unemotional traits in youth: A meta-analysis

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ABSTRACT

Callous-unemotional (CU) traits (i.e., lack of remorse or guilt, callous lack of empathy, deficient concern for the feelings of others) in youth with conduct problems confer risk for a particularly severe and persistent form of antisocial behaviour. Previous research has linked childhood maltreatment as a potential risk factor for CU traits, both primary (i.e., genetically underpinned) and secondary (i.e., environmentally influenced) variants, but findings have been inconsistent, and the association has not yet been tested in a meta-analysis. To address this gap, we conducted a meta-analysis to assess the nature and strength of the associations between childhood maltreatment and its subtypes with CU traits and potential variants (i.e., primary and secondary CU traits). A systematic search identified 29 eligible studies including 9,894 participants (42% female) between the ages of 3 and 18 years ($M_{age}=14.22$ years, $SD = 1.07$). Results revealed a significant moderate positive association between childhood maltreatment and CU traits. All subtypes of maltreatment bar sexual abuse were significantly associated with CU traits. However, it was not possible to compare primary and secondary CU traits directly due to inconsistencies in how they are defined. The limitations posed by current research signal the need for clinical and operational guidelines on how to define primary and secondary CU traits. Additionally, prospective longitudinal, genetically informed research is needed to clarify if maltreatment is a causal risk factor for CU traits.

Conduct problems (CP) in childhood and adolescence delineate a group of youth with behaviours that include aggression and violence as well as overt and covert ways of violating the norms of society. CP are associated with high rates of crime and substance misuse as well as problems that persist throughout adulthood including compromised mental and physical health, reduced interpersonal functioning, and poor educational and economic outcomes (Erskine et al., 2014; Rivenbark et al., 2018). In the UK, the financial costs associated with CP include mental health referrals, hospital admissions due to accidents, supplementary educational and social services, as well as the high costs to the justice system (D'Amico et al., 2014; Romeo et al., 2006). Worldwide, CP carry a heavy global health burden (Erskine et al., 2014) and are a major predictor of how much an individual will cost society (Burt et al., 2018; Kassing et al., 2018; Scott et al., 2001).

Within CP, there is considerable heterogeneity, with different symptom clusters and developmental trajectories (Fairchild et al., 2019). Efforts to identify more homogenous subgroups of CP have resulted in different subtyping approaches within the DSM-5, one of

which focuses on the presence of Limited Prosocial Emotions (LPE), indexing callous-unemotional (CU) traits (American Psychiatric Association, 2013). CU traits are defined by a characteristic lack of remorse or guilt, callous lack of empathy, and shallow or deficient concern for the feelings of others, which are the core affective features of psychopathy in adulthood (Frick et al., 2014b). CP co-occurring with elevated levels of CU traits have drawn considerable attention in recent years due to increased antisocial behaviours and reduced responding to socialization efforts and clinical interventions of this particular subgroup of antisocial youth (Viding and McCrory, 2012a). Indeed, there is now substantial evidence that CU traits identify a subgroup of youth with CP exhibiting particularly severe and persistent patterns of antisocial behaviour who might be at risk of developing the adult syndrome of psychopathy (Burke et al., 2007; Hawes et al., 2017). In addition, an extensive body of research indicates that youth with CP and elevated levels of CU traits i) are characterized by different environmental and genetic vulnerabilities (De Brito et al., 2021), and ii) differ behaviourally, emotionally, and neurocognitively from youth with CP and low

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levels of CU traits (Frick et al., 2014a). Findings from twin studies have shown a strong genetic influence on antisocial behaviour in children with elevated levels of CU traits, with 45–67% of the variance explained by genetic factors, while antisocial behaviour in children with CP alone is under strong shared and non-shared environmental influence (Fontaine et al., 2010; Viding et al., 2005).

There is, however, growing evidence of different aetiological pathways to CU traits (Cecil et al., 2018). Indeed, consistent with early theoretical views on the development of psychopathy (Karpman, 1941), youth with high CU traits can be further distinguished into two variants which are differentiated by their levels of anxiety (Kimonis et al., 2012). Youth with primary CU traits exhibit lower anxiety (Fanti et al., 2013) and these traits are thought to be genetically underpinned with fearless temperaments and deficits in processing emotional stimuli (Kimonis et al., 2012, 2008; Viding et al., 2012). In contrast, secondary CU traits are associated with higher levels of anxiety (Fanti et al., 2013) and are thought to develop through environmental trauma (Kimonis et al., 2013b; Wright et al., 2018). Supporting this distinction, an emerging body of research shows that primary CU traits are linked with greater genetic risk, while secondary CU traits are linked with higher rates of maltreatment histories (Cecil et al., 2018; Dadds et al., 2018; but see Humayun et al., 2014). Childhood maltreatment has been primarily linked with the development of secondary CU traits, but, contrary to a commonly-held view in the field, there is evidence that primary CU traits may be associated with a specific maltreatment history of neglect (Kimonis et al., 2013a). In the long term, neglect is at least as damaging as abuse but has received less scientific and public attention despite being the most frequent category of maltreatment reported by child-protection agencies in the USA, UK, and Canada (Gilbert et al., 2009). Indeed, early neglect in the form of severe institutional deprivation has been associated with CU traits in adolescence (Kumsta et al., 2012). This suggests that youth with primary and secondary CU traits could be differentiated according to subtypes of maltreatment as opposed to presence or absence of maltreatment.

Childhood maltreatment, a global problem with lifelong consequences, is defined as physical abuse, sexual abuse, emotional abuse, physical neglect, and/or emotional neglect in the context of a relationship of power, trust, or responsibility, which results in harm to the health, survival, development, and dignity of children under the age of 18 years (World Health Organization, 2020). When compared with other forms of childhood adversity (e.g., natural disasters, war trauma, accidental injury), childhood maltreatment may give rise to a distinct form of developmental trauma that is uniquely associated with interpersonal abuse and neglect over-and-above the effects of PTSD symptomology (van Der Kolk et al., 2019). The emergence of CU traits may therefore be a functional adaptation to childhood maltreatment by way of blunted emotional responding that develops as a survival response to protect the relationship with the abuser and the self from a painful reality (Del Giudice et al., 2011). There is accumulating research that callousness may arise out of adaptation to interpersonal trauma (Bennett and Kerig, 2014; Kahn et al., 2013; Kimonis et al., 2011; Krischer and Sevecke, 2008).

There is substantial evidence linking maltreatment to antisocial behaviour in general (Dadds et al., 2018) and to psychopathy in adulthood (de Ruiter et al., 2022). In a recent meta-analysis, de Ruiter and colleagues (2022) found a moderate positive association ($r = .11-.26$) between childhood maltreatment and adult psychopathy across 47 studies ($N = 12,737$) supporting theoretical models and empirical research implicating maltreatment as one potential risk factor for psychopathy. However, similar meta-analytic research in children and adolescents has not yet been undertaken. The nature of the association between childhood maltreatment and CU traits in youth is also less well established because findings have been inconsistent. Interpretations of findings are further complicated by conflicting methods for defining primary and secondary CU variants, with some studies using symptoms alone (e.g., anxiety levels), putative risk factors alone (e.g.,

maltreatment), or a combination of symptoms and putative risk factors (Craig et al., 2021). However, theoretical tradition (e.g., Karpman's theory of psychopathy) is based on phenotypic presentation (e.g., anxiety) which is hypothesized to be related to causal pathways (Karpman, 1941). The role of maltreatment may vary across and within symptom profiles for the two CU variants, reflecting different causal pathways and transactional processes between environment and genetic constitution. Therefore, putative risk factors such as maltreatment should be excluded from a priori designation of variants so that alternative pathways to different symptom profiles can be investigated. Thus, in the current study, primary and secondary variants of CU traits will be defined by anxiety levels in line with Karpman's original position.

While the majority of existing studies point to a positive association between maltreatment and CU traits (e.g., Craig and Moretti, 2019; Kimonis et al., 2017; Xie et al., 2020), findings are inconsistent. Kimonis et al. (2011) found no association, $r = .00$, overall and a negative association for the physical, $r = -.09$, emotional, $r = -.07$, and sexual, $r = -.25$, abuse subscales of the Childhood Trauma Questionnaire (CTQ) among 14- to 17-year-old participants. In contrast, Xie et al. (2020) found positive associations between maltreatment and CU traits, $r = .12 - .36$, among 12- to 18-year-old participants. Fanti et al. (2020) found positive associations for all subscales, $r = .13-.34$, except for sexual abuse, $r = -.05$.

Findings are also inconsistent in studies comparing primary and secondary CU variants (defined by anxiety alone). Despite the widely held view that maltreatment is not involved in the emergence of primary CU traits, longitudinal data show that youth with primary CU traits may also have maltreatment histories (Goulter et al., 2017). Twin data show no differences in histories of harsh punishment in youth with primary and secondary CU variants (Humayun et al., 2014). In a more recent study, while youth with secondary CU traits showed higher levels of early risk in non-maltreatment measures (i.e., family adversity and maternal psychopathology), youth with primary and secondary CU variants did not differ in experiences of harsh parenting (Meehan et al., 2017). Deskalo (2016) found positive associations for abuse and neglect with no significant differences between youth with primary and secondary CU variants. Similar findings in other studies show that both groups report histories of maltreatment (Kimonis et al., 2012; Tatar et al., 2014). Thus, findings for young people with primary CU traits show the presence of maltreatment histories that are either reduced or commensurate with those of youth with secondary CU traits. Nevertheless, many of these studies examined harsh parenting without specific focus on maltreatment. There is currently a paucity of research examining maltreatment subtypes while also using only anxiety to differentiate the two variants of CU traits. The data reviewed above suggest that youth with both CU variants have maltreatment histories. However, no study has formally tested this hypothesis through a systematic meta-analysis documenting the direction and strength of associations between maltreatment and CU traits.

In this context, the present pre-registered meta-analysis is the first to test the associations between childhood maltreatment and CU traits in youth aged 0–18 years by addressing four aims. The first aim is to examine whether there is an association between childhood maltreatment and CU traits in youth. If CU traits are shaped by maltreatment, then we anticipate a positive association between the main study variables. On the other hand, if only secondary CU traits are associated with maltreatment, the link will be stronger between maltreatment and secondary CU traits than between maltreatment and primary CU traits or the overall association. The second aim is to investigate whether different subtypes of childhood maltreatment show different associations with CU traits. Preliminary evidence suggests some subtypes of maltreatment might be particularly associated with CU traits. The third aim is to investigate whether overall maltreatment shows associations with specific CU subgroups (i.e., primary and secondary variants differentiated by levels of anxiety). Given recent findings that neglect may be associated with primary CU traits, the fourth aim is to ascertain

whether specific subtypes of childhood maltreatment (i.e., neglect and abuse) are associated with CU variants. Finally, given the variation in existing findings, we examine potential moderators arising from methodological differences between studies.

1. Method

1.1. Protocol and open data

This meta-analysis was pre-registered on July 22, 2021, on PROSPERO, an international prospective register of systematic reviews. The registration can be found with the ID: CRD42021264408 on their website: (<https://www.crd.york.ac.uk/PROSPERO/>).

1.2. Inclusion and exclusion criteria

Studies were included if they met the following criteria: 1) were empirical, 2) included a measure of CU traits and a measure of maltreatment, 3) included a sample aged between 0 and 18 years at the time of CU trait measurement, 4) used a sample drawn from clinical, correctional, and/or community settings, 5) specified at least one of the maltreatment criteria (i.e., physical abuse, sexual abuse, emotional abuse, physical neglect, emotional neglect). When a sample included youth over the age of 18 years, data were requested from primary authors for only those participants between 0 and 18 years of age. Studies were excluded if they focused on adversities outside the primary caretaking environment (i.e., war trauma, community violence, natural disasters) or if they focused on the loss of a parent or accidental injury.

1.3. Search strategy

Studies were identified through searching online databases (i.e., Scopus, PsychINFO, Medline, and Web of Science) for publications and grey literature (e.g., dissertations) after 1994, when the first paper on CU traits was published (Frick et al., 1994). Initial searches were run in July 2021, followed by monthly searches for new publications until July 2022. Search terms included the following: (*Trauma** OR *complex trauma* OR *childhood trauma* OR *abus** OR *adverse childhood experience* OR *neglect* OR *maltreat** OR *ill-treatment* OR *betrayal trauma* OR *physical abuse* OR *emotional abuse* OR *sex abuse* OR *sexual abuse* OR *physical neglect* OR *emotional neglect*) AND (*callous-unemotional traits* OR *callous** OR *CU Traits* OR *ODD* OR *oppositional defiant disorder* OR *CD* OR *Conduct Disorder* OR *antisocial* OR *anti-social* OR *psychopathic* OR *disruptive behavior* OR *externaliz** OR *externalis**) AND (*youth** OR *adolescen** OR *child** OR *juvenile*). Searches were limited to studies of children and adolescents between the ages of 0 and 18 at the time of CU trait measurement. If articles had insufficient data after meeting criteria, additional information was requested from the corresponding authors.

1.4. Study selection

The literature search generated 28,211 studies, of which 10,921 duplicates were removed. Of the remaining 17,290 studies, all were screened by the primary author for eligibility by examining the title and abstract. A subsample of 40 studies was selected for title and abstract screening by a second research student to assess inter-rater reliability ($\kappa = .86$). A total of 65 studies were eligible for full-text screening and retrieved. All 65 studies were screened by a second research student for reliability ($\kappa = .96$). Reference lists were also searched to further identify any studies undiscovered in the data base searches. In the full-text screening, studies were checked for an appropriate definition and assessment of the variables of interest and samples that were between the ages of 0–18 years. Uncertainty on the eligibility of studies was resolved through discussion between all authors. PRISMA guidelines were followed (Moher et al., 2009).

1.5. Data extraction

The following data were retrieved from all studies meeting the inclusion criteria: type of publication and year, country of study, total sample size, sample sex distribution, sample age range, sample mean age and standard deviation, type of sample (i.e., clinical, correctional, or community), study design (i.e., cross-sectional or longitudinal), childhood maltreatment measure and respondent, CU trait measure and respondent, and effect sizes for each type of maltreatment reported. When the above data could not be obtained from the text, the primary corresponding author was contacted. The first author undertook data extraction, but all authors had to agree on study inclusion.

1.6. Study quality assessment

To address the methodological quality of studies assessing the association between childhood maltreatment and CU traits, we adapted the Newcastle-Ottawa Quality Assessment Scale (Wells et al., 2009) to include questions relevant to our meta-analysis (see the [supplementary material](#)). Our additions included how CU traits were assessed (i.e., self-report=0, parent, teacher, or other report=1, multiple informants=2, semi-structured interview by a trained rater=3, semi-structured interview with file review=4), whether maltreatment was reported by different informants (i.e., self-report only=0, parent or teacher or other report=1, documented=2), and whether sample size was sufficiently large enough to detect medium effects (0 =underpowered, 1 =well-powered). We derived an overall quality score (range = 0 – 11) for each study by summing the results across all items. Higher scores indicated studies with greater methodological rigour.

1.7. Effect sizes

The Pearson correlation coefficient r , the preferred effect size for meta-analyses of correlational data (Quintana, 2015), was chosen as the effect size index because the majority of studies reported correlational data to quantify associations between childhood maltreatment and CU traits. Where possible, coefficients were extracted directly from zero-order correlation matrices. Missing effect sizes were obtained by contacting the corresponding authors.

The method used to interpret effect sizes followed recent research which highlights a need for shifting current thresholds. Perhaps the most widely used standard for interpretation of effect sizes has been Cohen's impression-based guidelines that Pearson's r correlations be set at thresholds of .10, .30, and .50 and interpreted as small, medium, and large, respectively (Cohen, 1992). However, more recent research in systematic quantitative analyses has questioned this line of interpretation because it was based on qualitative impressions. When Cohen's guidelines were evaluated from an empirical perspective comparing 708 meta-analytically driven correlations, fewer than 3% of studies reported correlations as large as $r = .50$, and the overall average effect size was .19 (the 25th and 75th percentile were .11 and .29, respectively). These authors suggest that a more normative interpretation of statistical results would be to recast the guidelines to .10, .20, and .30 as small, moderate, and relatively large, respectively (Gignac and Szodorai, 2016). Indeed, a very large effect size of $r = .4$ or greater is likely to be an overestimate that is rarely found in large samples or replications (Funder and Ozer, 2019). Additionally, the interpretation of effect sizes as stand-alone results can contribute to misinterpretation because a small effect size in a single event can be non-significant, but very significant in a larger event (Funder and Ozer, 2019). Following a recent meta-analysis (de Ruiter et al., 2022) on childhood maltreatment and psychopathy in adults that used these same guidelines, we interpret our results in line with the newer guidelines outlined above and compare our results with current findings in the broader context of psychopathology.

Consistent with established guidelines (Quintana, 2015), in cases where the authors published multiple manuscripts but used the same

sample, only one study was included. Where overall effect sizes were reported for measures of youth psychopathic traits known to have a CU trait subscale, the corresponding author was contacted for the subscale effect size. Where possible, separate effect sizes for overall maltreatment, physical abuse, sexual abuse, emotional abuse, physical neglect, and emotional neglect were obtained from the same paper.

1.8. Meta-analysis

This quantitative data synthesis was conducted in R (R Core Team, 2018) as a random-effects meta-analysis because studies were drawn from different populations, making a fixed-effects model inappropriate as it does not account for heterogeneity (Quintana, 2015). The between study variance was assessed using τ^2 (tau-squared) with restricted maximum likelihood method (REML) which assigns weights to each study by the inverse of the total variance and tends to be less biased than other popular methods (Veroniki et al., 2016). Using τ^2 to reflect the variance of true effects in absolute terms, I^2 was used to quantify the relative amount of true heterogeneity between studies. I^2 thresholds of 25%, 50%, and 75% represent low, moderate, and high variance, respectively (Higgins et al., 2003; Quintana, 2015). Potential sources of heterogeneity were investigated through meta-regression.

To investigate the differences between maltreatment subtypes, we used a multilevel meta-analysis because multiple effect sizes were embedded within individual studies. The multilevel meta-analytic model tests variance at three levels (i.e., sampling variance, between study variance, and within study variance) thereby accounting for dependency of multiple effect sizes from the same study (Cheung, 2014; Van den Noortgate et al., 2013).

A correction for attenuation analysis was also performed. Correction for attenuation is needed to address internal consistency bias issues which are due to measurement error. Following previous meta-analyses where correction for attenuation was warranted due to the frequent occurrence of low reliabilities among CU trait measures (de Ruiter et al., 2022; Waller et al., 2020), we corrected for attenuation after initial findings. Influential effect sizes were examined using the leave-one-out method by comparing the model with and without each individual study to test whether the effect size was changed significantly by the removal of a given study (Viechtbauer and Cheung, 2010).

We undertook a series of moderator analyses to determine whether the association between childhood maltreatment and CU traits differed by 1) recruitment source (i.e., clinical, correctional, or community), 2) sample composition (i.e., gender and age), 3) study design (i.e., longitudinal or cross-sectional), 4) type of maltreatment measure (i.e., self-report or documented), 5) CU measure informant (i.e., self, parent, teacher, or combination), 6) the presence (or absence) of antisocial behaviour, 7) anxiety levels of participants, and 8) study quality. Consistent with recent meta-analyses on CU traits (Dugré et al., 2020; Rogers and De Brito, 2016), the Percent of Maximum Possible (POMP) scores were calculated for anxiety measures (Cohen et al., 1999). The Newcastle-Ottawa Quality Assessment Scale, a method used to measure the quality of observational studies included in meta-analyses (Luchini et al., 2021), was adapted to assess the quality of each study (see the [supplementary material](#)). To interpret the significance of our findings, and because a large portion of studies in the biobehavioural sciences are statistically underpowered, we conducted power analyses in R for overall power as well as for each individual study (Quintana, 2017).

1.9. Publication bias

The presence and impact of publication bias was investigated in three ways. First, funnel plots were generated in R and visually inspected. Second, the `weightr` package in R was implemented to examine publication bias through adjusting the weight of how much each study contributes based on its p-value. Third, to assess whether the included studies were biased to excluding studies with non-significant

results, Rosenthal's Fail-safe N (Rosenthal, 1979) was calculated to estimate the number of studies with an effect size of 0 needed to make the mean effect size non-significant ($p > .05$).

2. Results

2.1. Descriptive results

Fig. 1 (PRISMA Flow) provides a visual overview of the study selection process. The electronic database and hand searches identified 28, 211 studies of which 10, 921 duplicates were removed. The titles and abstracts of 17, 290 studies were screened for the presence of participants aged 0–18 years, measures of CU traits or psychopathy, and maltreatment resulting in 65 studies for full-text evaluation. Of these studies, 36 were excluded because they 1) did not include a childhood maltreatment measure ($k = 20$), 2) participants were over the age of 18 ($k = 12$), 3) the study did not include a CU trait measure ($k = 3$), 4) duplicate data were used ($k = 1$). Twelve authors were contacted for studies that did not report the necessary data (i.e., participants over the age of 18 were included or relevant correlations were missing) and data from author responses ($k = 8$) were included. There were 29 studies ($N = 9,894$) included in the meta-analysis. Sample sizes ranged from 26 to 2,407 participants. The mean age of the included samples at the time of CU trait measurement was 14.22 years (range = 3–18 years old). The recruitment source (i.e. clinical, correctional, or community), sample composition (i.e., gender and age), study design (i.e., longitudinal or cross-sectional), type of maltreatment measure (i.e., self-report or documented), CU measure informant (i.e., self-report, parent/teacher report, combination), anxiety scores and study quality were included as moderators. Antisocial behaviour was excluded due to the predominance of clinical and correctional samples in the included studies.

2.1.1. Study and sample characteristics

The papers included in this meta-analysis were published between the years 1994 and 2021. Twenty-six of the included studies were journal articles and three were dissertations. The included studies originated from North America ($k = 19$), Europe ($k = 4$), Asia ($k = 4$), Australia ($k = 1$), South America ($k = 1$). There was a total of 9,894 participants in the included studies, with sample sizes ranging from 26 (Cunningham, 2019) to 2,407 (Fang et al., 2020). The majority of the included papers used correctional or clinical samples ($k = 24$), with the remaining studies using either community or mixed samples ($k = 5$). Eleven samples were all male, one sample was solely female, and the remaining 17 were mixed. Further details about study and sample characteristics are given in Table 1.

2.1.2. Measure characteristics

The studies used a range of measures for childhood maltreatment and CU traits. To assess childhood maltreatment, the majority ($k = 25$) used retrospective, self-report measures such as the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1997). The remaining papers ($k = 4$) used a combination of parent and/or teacher report or official records. To assess CU traits, the majority ($k = 24$) used self-report measures such as the Inventory of Callous-Unemotional Traits (ICU; Frick, 2004) or the Youth Psychopathic Traits Inventory (YPI; Andershed et al., 2007) and the remaining studies ($k = 5$) used a semi-structured interview such as the Youth Version of the Psychopathy Checklist (PCL:YV; Forth et al., 2003). The average internal consistency for childhood maltreatment measures was $\alpha = .68$ (range = .04–.87) and for CU trait measures $\alpha = .69$ (range = .63–.94).

2.2. Meta-analytical results

2.2.1. Overall maltreatment and CU traits

There were 29 studies ($N = 9,894$) yielding 29 effect sizes included in the random effects model for overall maltreatment. There was a

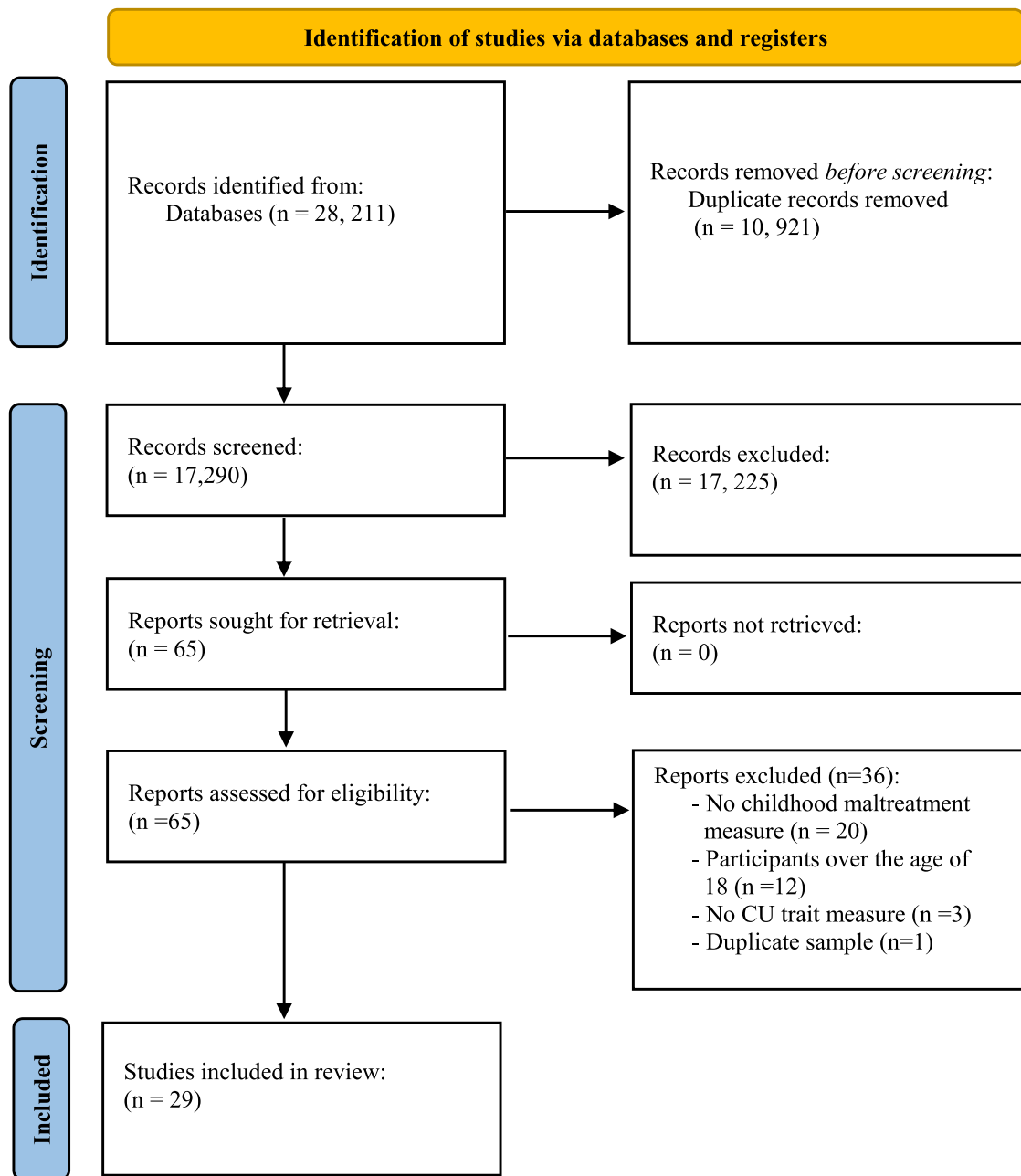


Fig. 1. Prisma Flow.

moderate significant positive association, $r = .19$, $p < .001$, 95% CI [.14, .24], between CU traits and overall maltreatment, and correction for attenuation yielded a moderate significant effect size, $r = .23$, $p < .001$, 95% CI [.17, .30]. The amount of heterogeneity among the 29 pooled effect sizes was high for studies not corrected for attenuation, $I^2 = 81\%$, and for studies corrected for attenuation, $I^2 = 88\%$. There were no influential effect sizes identified in the leave-one-out analysis. Removal of any one study did not yield any significant shifts in the confidence intervals before or after correcting for attenuation and resulted in effect size ranges between .19 and .20, 95% CI [.14, .24], .22 and .25, 95% CI [.17, .30], respectively.

2.2.2. Maltreatment subtypes and CU traits

To further elucidate the associations between maltreatment subtypes and CU traits, and to account for dependency of multiple effect sizes from individual studies, we used a multilevel meta-analytic model to test

maltreatment subtypes as moderators. This analysis revealed that sexual abuse was not significantly related to CU traits, $r = .07$, 95% CI [–.017, .163] (see Table 2). There were no significant differences between the other subtypes of maltreatment, which were all significantly and positively associated with CU traits: physical abuse, $r = .17$, 95% CI [.08, .25], emotional abuse, $r = .22$, 95% CI [.13, .31], physical neglect, $r = .23$, 95% CI [.13, .32], and emotional neglect, $r = .21$, 95% CI [.12, .30].

2.2.3. Primary and secondary variants

We were unable to investigate whether overall maltreatment showed associations with specific CU variants (i.e., primary and secondary variants) or whether subtypes of childhood maltreatment were associated with CU variants due to inconsistencies between studies in defining the variants. Indeed, most studies used a combination of childhood maltreatment and anxiety or childhood maltreatment as the defining

Table 1
Characteristics of included studies.

Author	N	M _{age}	% females	Country	Sample Type	CU traits measure	CU traits informant	CM measure	Maltreatment informant	Study design	Study Quality
Campbell et al. (2004)*	226	16.24	17	Canada	Correctional	PCL:YV	Clinician	AEQ ¹	Self-report	C	8
Craig and Moretti (2019)*	396	14.93	56.7	Canada	Clinical	ICU	Self-report	CTS ¹	Self-report	C	5
Cunningham (2019)* *	26	16.19	42.3	USA	Correctional	PCL:YV	Clinician	CTQ ^{1,2,3,4,5,6}	Self-report	C	7
Dackis et al. (2015)*	132	10.32	48.5	USA	Community	ICU	Counselor	State records ¹	Documented	C	7
Dadds et al. (2018)* *	364	8.93	28	Australia	Clinical	APSD	Parent, Teacher	MI ^{1,2,3,6}	Clinician, Teacher, Self-report	C	8
Deskalo (2016)* *	108	16	100	USA	Correctional	ICU	Self-report	Juvenile Mental Health Screening Form ^{1,2,4}	Self-report	C	4
Fang et al. (2020)*	2407	12.75	50	China	Community	ICU	Self-report	CTQ-SF ¹	Self-report	C	5
Fanti et al. (2020)* *	136	17.7	14	Netherlands	Correctional	YPI	Self-report	CTQ ^{1,2,3,4,5,6}	Self-report	C	4
Farina et al. (2018)*	253	16.24	45	USA	Correctional	YPI	Self-report	CTQ/ MAYSI-2 ¹	Self-report	C	5
FemNAT (unpublished data)* *	705	14.22	45	Europe	Mixed	ICU	Parent	CTQ ^{1,2,3,4,5,6}	Self-report	C	6
Gao et al. (2021)*	138	15.52	0	China	Clinical	APSD	Self-report	CTQ-SF ¹	Self-report	C	4
Kerig et al. (2012)*	276	16.16	24.6	USA	Correctional	ICU	Self-report	BBTS ¹	Self-report	C	5
Kimonis et al. (2008)*	88	15.57	0	USA	Correctional	ICU	Self-report	MAJOR ¹	Interview	C	4
Kimonis et al. (2011)*	116	15.82	0	USA	Correctional	PCL:YV	Interview	CATS ¹	Self-report	L	7
Kimonis et al. (2012)*	373	15.42	0	USA	Correctional	YPI	Self-report	LES ¹	Self-report	C	5
Kimonis et al. (2013b)* *	227	15.73	0	USA	Correctional	ICU	Self-report	CTQ ^{1,2,3,4,5,6}	Self-report	C	5
Kimonis et al. (2017)*	238	16.8	0	USA	Correctional	ICU	Self-report	CTQ ¹	Self-report	C	5
Kimonis et al. (2019a)*	232	16.75	0	USA	Correctional	ICU	Self-report	CTQ ¹	Self-report	C	5
Metcalf et al. (2020)*	167	14.84	61.7	USA	Community	APSD	Self-report	Documented ¹	Documented	C	6
Mozley et al. (2017)*	380	15.96	25	USA	Correctional	ICU	Self-report	PTSD-RI ¹	Self-report	C	5
Mozley et al. (2018)*	829	16.07	26	USA	Correctional	ICU	Self-report	PTSD-RI ¹	Self-report	C	5
Ometto et al. (2016)* *	107	12.85	44	Brazil	Clinical	PCL:YV	Clinician	CTQ ^{1,5,6}	Self-report	C	7
Portnoy et al. (2020)* *	135	11.83	44.3	China	Community	ICU	Self-report	CTSPC ^{1,2}	Self-report	C	5
Schraft (2015)*	80	10.42	44	USA	Clinical	APSD	Parent Teacher	CTSPC ¹	Primary caregiver	C	7
Sevecke et al. (2016)* *	341	17.64	50.1	Germany	Correctional	PCL:YV	Clinician	CTQ ^{1,2,4}	Self-report	C	8
Stoppelbein et al. (2021)*	91	10.44	0	USA	Clinical	ICU	Teacher	Documented/ ACE-SF ¹	Documented and Self-report	C	7
Tatar et al. (2014)*	373	16.42	0	USA	Correctional	YPI	Self-report	SLE ¹	Self-report	C	5
Vahl et al. (2016)* *	439	16.5	0	Netherlands	Correctional	YPI	Self-report	CTQ-SF ^{1,2,3,4,5,6}	Self-report	C	5
Xie et al. (2020)* *	585	15.88	0	China	Correctional	ICU	Self-report	CTQ-SF ^{1,2,3,4,5,6}	Self-report	C	5

Note. NR = not reported. AEQ = Abusive Experiences Questionnaire (unpublished). CTS = Conflicts Tactics Scale (Straus, 1979). CTQ = Childhood Trauma Questionnaire (Bernstein et al., 1997). MI = Maltreatment Index (Barnett et al., 1993). CTQ-SF = Childhood Trauma Questionnaire-Short Form (Bernstein et al., 2003). MAYSI-2 = Massachusetts Youth Screening Instrument Version 2 (Grisso and Barnum, 2006). BBTS = Brief Betrayal Trauma Survey (Goldberg and Freyd, 2006). MAJOR = Multifaceted Assessment of Juvenile Offender Risk (Trainham, 2000). CATS = Child Abuse and Trauma Scale (Sanders and Becker-Laussen, 1995). LES = Life Events Scale (Gil-Rivas, 2003). PTSD-RI = UCLA Posttraumatic Stress Disorder Reaction Index-Adolescent Version (Steinberg et al., 2004). CTS-PC = Parent-Child Conflict Tactics Scale (Straus et al., 1998). ACE-SF = Adverse Childhood Experiences-Short Form (Dube et al., 2003). SLE = Stressful Life Events Scale (Gil-Rivas, 2003), superscripts indicate which analyses were supported: ¹ = overall maltreatment, ² = physical abuse, ³ = emotional abuse, ⁴ = sexual abuse, ⁵ = physical neglect, ⁶ = emotional neglect, * = used for aim one of the analysis, ** = used for aims one and two of the analysis.

Table 2
Sexual Abuse Model Results.

Maltreatment subtype (df=64)	estimate	p	95% CI
sexual abuse	0.07	0.11	(-0.12, .16)
sexual abuse v physical abuse	0.09	0.04	(0.003, .18)
sexual abuse v emotional abuse	0.15	0.004	(0.05, .24)
sexual abuse v emotional neglect	0.14	0.005	(0.05, .24)
sexual abuse v physical neglect	0.15	0.002	(0.06, .25)
sexual abuse v total	0.17	< .001	(0.08, .25)

feature of secondary CU traits. Instead, we used anxiety as measured by the POMP scores, to test distinctions between primary and secondary variants. These analyses showed evidence for moderation, $Q_{\text{between}}(1) = 4.23, p = .04$, such that the correlations between maltreatment and CU traits were larger among samples with higher levels of anxiety than among samples with lower levels of anxiety (see Fig. 3; POMP results are in Table S.1 in the supplementary material).

2.2.4. Moderators

Meta-regressions for recruitment source (i.e., clinical/correctional or community) showed evidence for moderation such that clinical/correctional samples showed larger significant positive associations between overall maltreatment and CU traits, $Q_{\text{between}}(1) = 7.13, p = .01$, as compared with community samples. The proportion of females in the sample, youth age, study design (i.e., cross-sectional or longitudinal), type of maltreatment informant (i.e., self-report or documented), and type of CU informant (i.e., self, parent, teacher, or combination) did not moderate the association between childhood

maltreatment and CU traits (see Table 3). However, inspection of the scatter plot (Figure S.1 in the supplementary material) for age at CU trait measurement revealed a single outlier (Dadds et al., 2018). When the outlier was removed (Figure S.2 in the supplementary material), the association between childhood maltreatment and CU traits was stronger in younger children than in older children and adolescents, $\beta = -.03, p = .01$. The moderator analyses for the study design and the subtypes of maltreatment could not be carried out due to all subtype samples being cross-sectional designs. Similarly, while there was no evidence for moderation of association between the type of maltreatment measure (i.e., self-report or documented) and overall maltreatment, the moderator analyses for the type of maltreatment measure and the subtypes of maltreatment could not be carried out due to all measures being self-report. Meta-regressions for the presence or absence of antisocial behaviour were not possible due to the predominance of clinical and correctional populations used in all studies ($k = 25$). The moderator results for study quality were non-significant, $\beta = -.01, p = .51$. No single study met criteria for the maximum possible 11 points with 62% of the included studies using self-report measures for both maltreatment and CU traits. Only one study used a longitudinal design and 41% were underpowered for detecting medium effects. The overall power to detect an effect size of .19 for this meta-analysis was .99. To investigate if single-method bias impacted these findings, studies that used self-report measures for both CU traits and childhood maltreatment were tested separately against studies that used a combination of self and other reporting. Results of studies that used self-report measures for both ($k = 18$) were similar to findings for the total sample, $r = .24, p < .0001, 95\% \text{ CI } [.16, .32]$. Results of studies that used a combination of self and

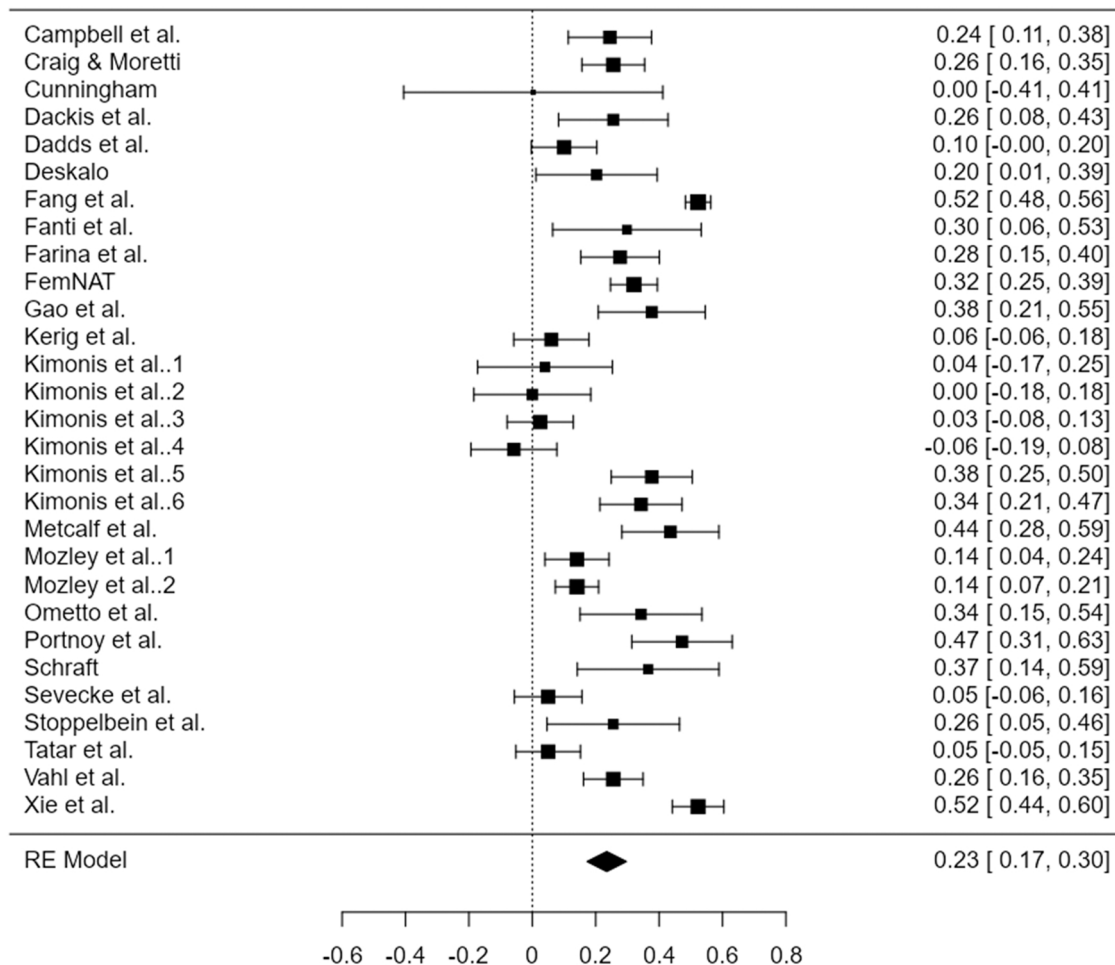


Fig. 2. Forest plot showing effect sizes for overall maltreatment.

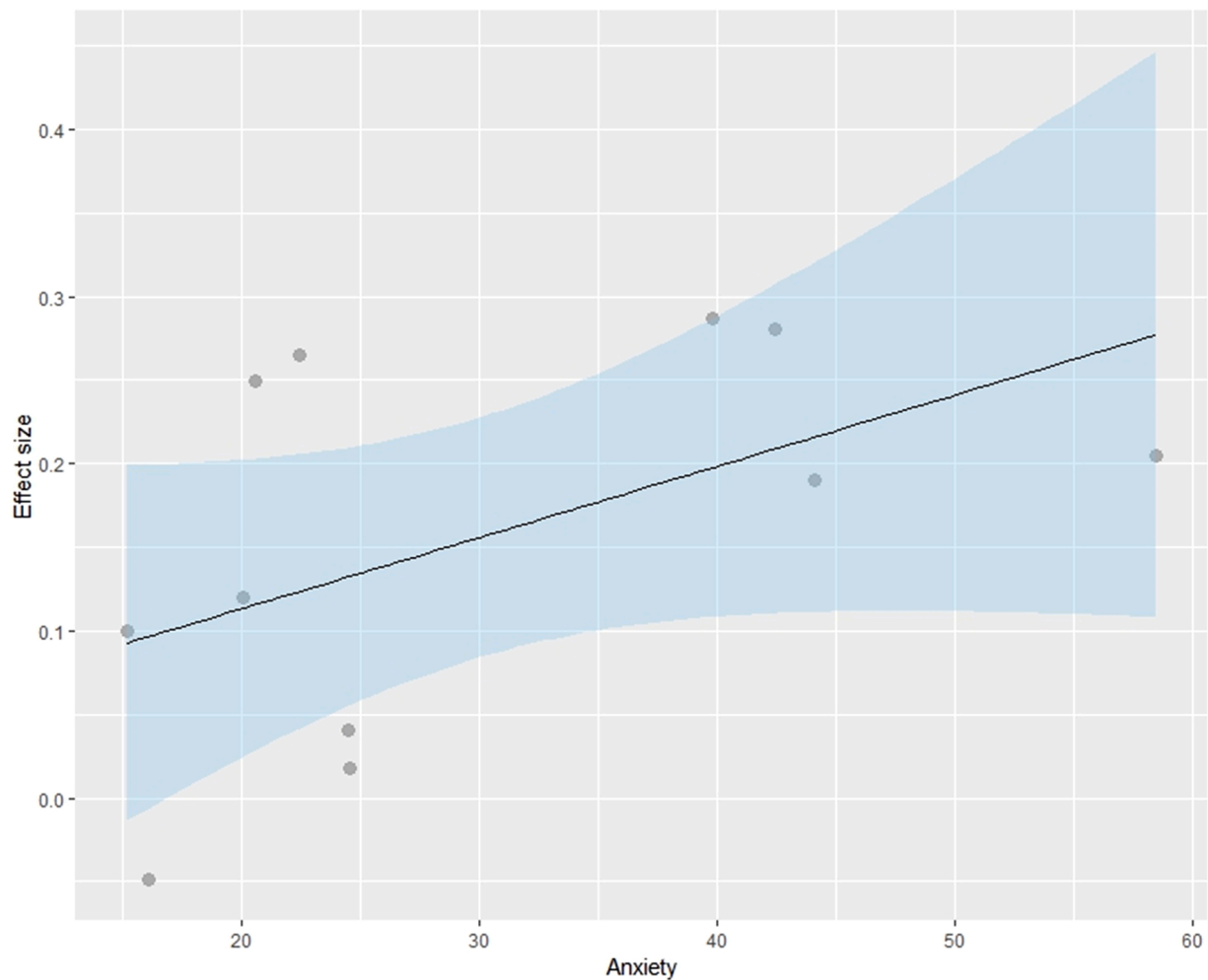


Fig. 3. Moderation results for anxiety.

other reporting for CU traits and maltreatment ($k = 11$) were also similar, $r = .22$, $p < .0001$, 95% CI [.14, .31].

2.2.5. Publication bias

Visual inspection of all funnel plots (Figure S.3. in the [supplementary material](#)) did not indicate an asymmetry suggesting a low risk for publication bias. However, because the funnel plot measures small study bias and publication bias is only one possible reason for funnel plot asymmetry (Balduzzi et al., 2019), publication bias was assessed using the `weightr` package in R which adjusts the weight of how much each study contributes based on its p value (Quintana, 2015). Results did not indicate evidence for publication bias ($p = .38$). Because Egger's regression test is better suited to meta-analyses with < 25 studies (Egger et al., 1997; Quintana, 2015), we did not use it for the overall analysis which included 29 studies. For the analyses of childhood maltreatment subtypes, Egger's regression tests were non-significant for the non-attenuated and attenuated analyses with ranges between $p = .16$ and $.93$, and $p = .30$ and $.45$, respectively. Rosenthal's Fail-safe N indicated that 550 studies showing no association between childhood maltreatment and CU traits would be needed to invalidate the findings.

3. Discussion

To our knowledge, this pre-registered meta-analysis was the first to test the association between childhood maltreatment and CU traits in youth aged 0–18 years. Our first aim was to establish the nature and strength of the association between overall childhood maltreatment and

CU traits. Across 29 included studies ($N = 9,894$), we found a moderate significant positive association between overall childhood maltreatment and CU traits. Our second aim was to examine associations between maltreatment subtypes and CU traits. All associations for the maltreatment subtypes were moderate and significant, except for sexual abuse which showed non-significant associations with CU traits. Our third and fourth aims (whether overall childhood maltreatment and whether maltreatment subtypes are associated with primary and secondary CU variants) could not be tested directly due to the inconsistencies in identifying and measuring CU subgroups. By defining subtypes using a putative causal or risk factor (e.g., maltreatment) rather than a phenotypical feature (e.g., anxiety), it was not possible to disentangle the links between childhood maltreatment and CU trait variants. Instead, we examined whether the association between childhood maltreatment and CU traits was moderated by reported mean anxiety levels. Supporting the distinction between primary and secondary CU traits, these analyses revealed that increased anxiety levels were associated with stronger correlations between maltreatment and CU traits. Apart from clinical and correctional samples, which showed stronger associations than community samples, effect sizes were consistent across other study and participant characteristics. However, the non-significant meta-regression for age became significant when one outlying study was removed suggesting stronger effects of childhood maltreatment in younger children.

With the exception of sexual abuse, our findings are consistent with that of a recent meta-analysis (de Ruiter et al., 2022) investigating the association between childhood maltreatment and psychopathy in adults,

Table 3

Estimates from models exploring moderation of the association between CU traits and childhood maltreatment outcomes by gender, age, sample type, informant, and sample design.

	β	z	p
Overall maltreatment (df = 28)			
Proportion female	-0.003	-1.18	0.24
Sample age	-0.02	-1.54	0.12
Sample type	-0.17	-2.67	0.01
Maltreatment informant	0.03	0.37	0.71
CU trait informant	-0.02	-0.33	0.74
Study design	0.02	0.14	0.89
Study quality	-0.01	-0.67	0.51
Anxiety	0.01	2.06	0.04
Physical abuse (df = 9)			
Proportion female	0.07	0.31	0.76
Sample age	-0.01	-0.78	0.44
Sample type	0.03	0.21	0.84
Maltreatment informant	all self-report		
CU trait informant	0.007	0.07	0.95
Study design	all cross-sectional		
Sexual abuse (df = 7)			
Proportion female	0.0001	0.03	0.97
Sample age	0.0007	0.02	0.99
Sample type	0.02	0.2	0.84
Maltreatment informant	all self-report		
CU trait informant	-0.002	-0.03	0.97
Study design	all cross-sectional		
Emotional abuse (df = 6)			
Proportion female	0.13	0.58	0.56
Sample age	-0.0001	-0.005	0.99
Sample type	0.11	1.08	0.28
Maltreatment informant	-0.02	-0.18	0.86
CU trait informant	0.12	0.91	0.69
Study design	all cross-sectional		
Emotional neglect (df = 7)			
Proportion female	-0.23	-1.08	0.28
Sample age	0.02	1.06	0.29
Sample type	-0.11	-0.95	0.34
Maltreatment informant	-0.13	-1.08	0.28
CU trait informant	-0.11	-1.4	0.16
Study design	all cross-sectional		
Physical neglect (df = 7)			
Proportion female	0.07	0.31	0.76
Sample age	-0.02	-0.5	0.62
Sample type	0.03	0.21	0.84
Maltreatment informant	all self-report		
CU trait informant	0.007	0.07	0.95
Study design	all cross-sectional		

Note. This table presents estimates from moderation analyses exploring whether gender, age, sample type, informant, anxiety, or study design moderation the association between CU traits and overall maltreatment, physical abuse, sexual abuse, emotional abuse, emotional neglect and physical neglect. Results are based on single variable moderator models where each moderator was entered into a separate model. Note that where moderator analyses were not possible due to all variables being the same, this is indicated by "all" and the variable.

which found a moderate, positive association ($r = .23$) between overall childhood maltreatment and psychopathy. Analyses for the subtypes of maltreatment were consistent with ours: physical abuse, $r = .22$, emotional abuse, $r = .17$, and neglect, $r = .25$. Our results extend the developmental scope of this work and when viewed alongside previous work, indicate that the nature and strength of the association between childhood maltreatment and callous-unemotional traits are largely consistent across the lifespan.

Meta-analytic data indicate that childhood maltreatment is associated with a range of negative physical and mental health outcomes and adverse psychosocial adjustment across the lifespan (Carr et al., 2020). These findings include depressive disorders, $r = .17 - .29$ (Nelson et al., 2017), anxiety disorders, $r = .17 - .25$ (Gardner et al., 2019), ADHD, $r = .28$ (Clayton et al., 2018), substance abuse, $r = .21$, (Halpern et al., 2018), and features of personality disorders, $r = .19 - .46$ (Khaleque,

2014). These examples place our results in the broader context of other mental health outcomes associated with maltreatment, including some that frequently co-occur with CU traits and psychopathy. Considering that studies with larger effect sizes are relatively rare, our findings support a growing body of research linking childhood maltreatment to negative mental health outcomes broadly, and here with CU traits.

3.1. Explaining associations between maltreatment and CU traits

Since maltreatment is related to both CU traits and adverse mental health outcomes it is possible that the association reflects a mere correlation (Kraemer et al., 1997). Given the range of mental health and personality difficulties associated with childhood maltreatment (i.e., multifinality), the direction and intensity of outcomes may be underpinned by variations in genetic risk. There are moderate to large heritability estimates for CU traits (Fontaine et al., 2010; Viding et al., 2005; Viding and McCrory, 2012b) and for many personality traits and psychiatric disorders (Polderman et al., 2015). Increasingly, findings are also emphasizing the malleability of early heritable risks for CU traits (Henry et al., 2018) and for antisocial behaviour (Burt et al., 2021). Developmental antecedents and sequelae likely develop through multiple pathways (i.e., equifinality) that involve a complex interplay between genetic inheritance and early environments (Frick et al., 2014a) resulting in varied outcomes (e.g., primary or secondary CU traits). There are therefore several potential explanatory models for the observed associations between childhood maltreatment and CU traits. Importantly, these models represent potential contributions to causal pathways and are not mutually exclusive (i.e., they likely co-occur in varied ways). That is, like players on a stage, time-specific entrances and exits and one playing many parts (Shakespeare, 1598/2006), each model may have time-specific effects and cumulative effects may contribute to differential outcomes.

First, a direct effects model suggests that maltreatment/insensitive caregiving act as environmental influences on CU traits. Inadequate caregiving has been consistently associated with CU traits in childhood and adolescence (Kimonis et al., 2013a; Larsson et al., 2008; Pasalich et al., 2011; Waller et al., 2012). For example, early experiences of neglect may influence CU traits through unresponsive and emotionally cold parenting (Bisby et al., 2017) that results in the blunted development of moral emotions (i.e., empathy and guilt) which underpin CU traits (Frick et al., 2014a). Early neglect in the form of severe institutional deprivation has been associated with CU traits in adoption studies (Humphreys et al., 2015; Kumsta et al., 2012). Neglect could influence the characteristics currently attributed to youth with low-anxious, primary CU traits (e.g., deficits in emotional processing and arousal). Caregiver-perpetrated abuse, currently better documented in the field, may result in hyperarousal and overwhelming levels of negative affect that lead to the blunted development of moral emotions currently associated with high-anxious, secondary CU traits (Craig et al., 2021). That is, youth who experience caregiver-perpetrated abuse may experience emotional numbing, which might manifest as CU traits (Kerig et al., 2012).

Second, in an evocative gene-environment correlation model, children may evoke harsher parenting practices making it harder for parents to interact with them in warm and sensitive ways (Fanti and Munoz Centifanti, 2014; Hyde et al., 2016). Reduced anxiety in response to parental sanctions may result in harsher responses when parenting practices that work with typically developing children fail with fearless and emotionally under-aroused children. It is also plausible that some parents disengage (e.g., neglect) when their child's behaviours are difficult in the extreme. Positive parenting may be particularly important for children who are high in trait fearlessness (Waller et al., 2016). Thus, children who evoke harsh responses from parents may be precisely the children who are temperamentally the most vulnerable to the type of parenting they receive (i.e., primary CU traits). Alternatively, youth with secondary CU traits may have greater tendencies for reactive

aggression (Kimonis et al., 2011) that are underpinned by higher negative affect and emotion dysregulation. These children may behave in impulsive, dysregulated ways which evoke harsher parenting practices. Importantly, the interactions of child-driven effects on parenting characteristics and parental effects on child behaviour share a bidirectional influence (Larsson et al., 2008), making parenting practices (discussed below) and child driven effects interdependent. Additionally, child-driven effects would need to be considered with respect to a direct effects model because a child's behaviour would be influenced by the presence of any direct effects of maltreatment.

A third possibility is that a passive gene-environment correlation might contribute to associations between maltreatment and CU traits. Children whose genetic inheritance includes predispositions for CU traits could be the offspring of parents with psychopathic traits (Fairchild et al., 2019). Parental maltreatment, in addition to being an environmental influence on CU traits, may also reflect parents' own CU traits. Parents who have emotional deficits (e.g., interpersonal callousness, lack of empathy) associated with CU traits would be at increased risk for parenting with abusive or neglectful behaviours. Their offspring may have the double burden of genetic predisposition for callousness as well as environmental reinforcement through callous behaviours of the parent. With respect to primary and secondary variants of CU traits, children of parents who have CU traits would be at risk for both. They would share genetic risk (i.e., primary variants) as well as environmental risk (i.e., secondary variants). Research has typically divided youth with CU traits into two groups, but this model suggests the possibility that some youth with high-anxious secondary CU traits have emotion processing deficits that may be genetically underpinned (as opposed to acquired), or that the genetic underpinnings of low-anxious primary variants (e.g., deficits in emotional arousal and processing) are reinforced through the experience of neglectful parents with CU traits.

Fourth, in a genetic moderation model, a child's temperament may influence how susceptible the child is to developing CU traits (Augustine and Stifter, 2015; Hughes et al., 2020; Slagt et al., 2016). Children at genetic risk for CU traits may have specific vulnerabilities to certain types of parent-child interactions (Cornell and Frick, 2007). In a meta-analysis of 84 longitudinal studies with children up to 18 years, children with more difficult temperaments showed increased vulnerability to negative parenting, but this group of children also profited more from positive parenting (Slagt et al., 2016). With respect to CU traits, Takahashi et al. (2021) found that rather than being conceptualized as factors of stability, genes play a dynamic role in subsequent CU trait expression or suppression. That is, genetic effects were found to be different for initial risk and subsequent CU trait development depending on environmental influences (Takahashi et al., 2021). This is, perhaps, not surprising given the critical role that the social environment plays in the regulation of gene expression (Champagne, 2010). At present, the genetic model has been most associated with primary variants (e.g., fearless temperaments). It could be hypothesized that youth with secondary CU traits may be characterized by anxious temperaments. They may be more prone to experience negative emotions across many situations. Fearful temperaments (e.g., elevated levels of negative affect) have been linked to subsequent development of anxiety symptoms (Gartstein et al., 2010; Pérez-Edgar and Fox, 2005). Youth with secondary CU traits may be temperamentally vulnerable to experiences that heighten negative affect and emotion dysregulation which could explain why some maltreated children are less resilient than others. Thus, temperament may predispose an individual to have low levels of anxiety (e.g., fearless temperament) or high levels of anxiety (e.g., fearful temperament) which may result in different transactional processes with the environment to, in turn, contribute to different aetiological pathways for primary or secondary CU traits. Importantly, children with increased genetic liability and elevated experiences of maltreatment may exhibit associations between maltreatment and CU traits that partly reflect genetic confounding (Baldwin et al., 2022).

Fifth, in an environmental moderation model, CU traits can be

attenuated by high-quality parenting. Responsive, warm parenting may buffer the effects of heritable risks for CU traits (Hyde et al., 2016; Takahashi et al., 2021; but see Humayun et al., 2014). Recent work has shown that parental warmth moderates the role of genetic influence on CU traits such that heritability was lower when children in twin studies received higher levels of warm and rewarding parenting (Henry et al., 2018; Hyde et al., 2016; Waller et al., 2018). Moreover, high quality foster care for children who experienced severe institutional deprivation mitigated the development of CU traits (Humphreys et al., 2015). Adopted children with temperamental vulnerability for CU traits (i.e., high fearlessness) had higher CU behaviours only when lower positive parenting styles were present in the mothers (Waller et al., 2016). Thus, environmental factors might attenuate or amplify genetic and environmental risk for both variants of CU traits.

Finally, although a lack of empathy is central to CU traits, causal theories of CU traits have not integrated research on how empathy develops (Frick and Kemp, 2021). In a mediation model, maltreatment may influence aspects of CU traits such as empathy and self-regulation development via disruption to attachment security. Secure attachment might predict moral development (i.e., empathy and guilt) in children who are temperamentally fearless and less responsive to punishment (Cornell and Frick, 2007; Kochanska, 1995, 1997). Research shows that empathy is a precursor for the development of self-regulation (Frick and Kemp, 2021). Longitudinal data show that the quality of early caregiver-child relationships predicts later regulatory skills because an attuned, adequate caregiver enables down-regulation to occur when a child experiences physical or emotional distress (Bernier et al., 2015; Fearon et al., 2010; Groh et al., 2017). Over time, reliable experiences in being regulated (i.e., secure attachment) develop the neural circuitry for self-regulation (Moutsiana et al., 2014) and the quality of the parent-child relationship may enhance a child's ability to develop empathy (Kochanska et al., 2005; Waller et al., 2018; Wright et al., 2018). Research in developmental trauma shows that children who experience maltreatment within the context of primary caregiving relationships may experience developmental disruptions in secure attachment and emotion regulation (D'Andrea et al., 2012; Ford, 2017; Spinazzola et al., 2021). Indeed, it was through studying maltreated infants that the delineation of the disorganized attachment pattern was discovered, a pattern infrequently seen in non-maltreated children and frequently seen in youth with higher levels of CU traits and adults with psychopathy (De Brito et al., 2021; Kohlhoff et al., 2020; Pasalich et al., 2012; Rogosch and Cicchetti, 2004). Thus, attachment may play a role in the development of empathy, which is central to understanding the aetiology and treatment of both CU trait variants.

3.2. Moderators of the association between maltreatment and CU traits

Apart from sexual abuse (discussed below), our results do not suggest that any one subtype of maltreatment is more strongly related to CU traits overall. One possible explanation for this is that different forms of maltreatment co-occur (Debowska et al., 2017; Haahr-Pedersen et al., 2020). For example, in 4,000 children who were 0–17 years old, over 40% directly experienced more than one form of violence or abuse and 10% had six or more direct experiences (Finkelhor et al., 2015). The cumulative effects of early adversity have been linked to the severity of outcomes such that whether one victim of abuse manifests clinical levels of distress more than another victim may depend upon the full burden of lifetime victimization (Hamby et al., 2018). Thus, multiple forms of maltreatment tend to co-occur and may have an extended and more severe biopsychosocial impact over and above exposure to specific types of maltreatment (Ford and Delker, 2018).

The moderator analysis showed that effect sizes differed between clinical/correctional samples and community samples. The clinical and correctional samples showed stronger associations between childhood maltreatment and CU traits than community samples. This is in keeping with what would be expected because clinical and correctional

populations are more likely to have histories of maltreatment and more extreme levels of CU traits than community samples (Bebbington et al., 2021; Bodkin et al., 2019; De Brito et al., 2021). In contrast to our findings, de Ruiter et al. (2022) found evidence for weaker associations with respect to clinical and correctional samples in their meta-analysis on childhood maltreatment and psychopathy in adults. It could be speculated that the variety of measures used across studies, and the predominance of self-report measures, could contribute to those divergent results.

The moderator analysis for age became significant when a single outlier was removed suggesting that correlations between maltreatment and CU traits were stronger in younger children than in older children. This suggests that effects of maltreatment on CU traits may be more pronounced with greater proximity to experiences of maltreatment. The results might also reflect that the timing of maltreatment may be important to consider. Indeed, there is evidence to suggest that outcomes may vary in consistent ways depending on when the maltreatment occurs. For example, when the age of onset was investigated in 0–11-year-olds, those who experienced an earlier onset of maltreatment had more internalizing problems in adulthood and those who experienced a later onset of maltreatment had more behavioural problems as adults (Kaplow and Widom, 2007). Furthermore, different genes may have periods of elevated risk (Takahashi et al., 2021) and specific brain regions (e.g., amygdala, hippocampus, frontal cortex, and corpus callosum) may have sensitive periods during development that increase vulnerabilities for long term negative effects from maltreatment (Andersen et al., 2008). In a study measuring amygdala responses to threatening or salient stimuli, those children with early maltreatment exposure (i.e., pre-pubertal) had blunted responses whereas children with later exposure (i.e., post-pubertal) had exaggerated responses suggesting that maltreatment in sensitive exposure periods contributes to whether emotional responding will be attenuated or exaggerated (Zhu et al., 2019).

The overall power of this meta-analysis to detect moderate-to-large effects was high. Except for sample type, overall anxiety levels, and to some extent age, our results did not show evidence for moderation which suggests that the association was robust to variations within samples. High heterogeneity could be due to factors such as different definitions of maltreatment in the included studies, unreported age and duration of the maltreatment, or types of protective factors unexplored (i.e., whether or not parental warmth and sensitivity was present in one parent where maltreatment occurred with the other, or whether there was at least one secure attachment with a primary caregiver).

3.3. Implications for theory and practice

One important limitation of the current evidence base is that maltreatment history is often used to distinguish between primary and secondary CU trait variants. As such, we were unable to test directly whether maltreatment was more strongly associated with secondary CU traits than with primary CU traits. However, we created POMP scores for the studies that reported anxiety scores. The anxiety moderator was small but significant supporting Karpman's (1941) theory that the association between maltreatment and CU traits is stronger at high levels of anxiety. These results need to be interpreted cautiously, however, given that only a subsample of studies were included ($k = 11$) while the majority of studies either did not measure anxiety, did not report anxiety measure results, or did not respond when results were requested. Notwithstanding, our results indicate that associations between maltreatment and CU traits are stronger in the context of high levels of anxiety suggesting that maltreatment may be a greater causal risk factor for secondary CU traits than primary CU traits. However, because we could not analyse maltreatment subtypes associated with primary and secondary variants, we could not investigate whether this result may be higher for the maltreatment subtypes that are hypothesized to correlate with primary and secondary variants (e.g., neglect and abuse histories

with primary and secondary variants, respectively). Taken together, our findings highlight an urgent need for a shift in the ways primary and secondary CU traits are conceptualized because if secondary variants are defined in part by putative causal risk factors (i.e., maltreatment) rather than phenotypical characteristics (i.e., anxiety levels, patterns of scores on ICU subscales) future studies will be unable to explore the potentially significant contribution of maltreatment and its subtypes to the development of CU trait variants.

Support for the view suggesting that CU traits develop through interpersonal maltreatment has preventative and treatment implications. Therapeutic interventions that focus on parent-child interactions early in development with specific emphasis on children with CP (e.g., Integrated Family Intervention for Child Conduct Problems; Dadds and Hawes, 2006; Dadds et al., 2019) and CU traits (e.g., Parent-Child Interaction Therapy-Callous Unemotional Adaptation; Kimonis et al., 2019b; Fleming et al., 2022) can contribute to understanding developmental trajectories and preventing severe CP and CU trait development. Additionally, high risk periods might be coupled with high-reward periods in which interventions are more likely to result in long-term, positive health outcomes (Dunn et al., 2020). In the broader context, findings could have implications for prevention against the development of psychopathy in adulthood.

Finally, our analysis indicates the potential presence of biases due to measurement error. Compared with results corrected for attenuation, when measurement error was not considered the associations between maltreatment and CU traits were weaker. Additionally, when we tested the relationship between maltreatment subtypes and CU traits in a multilevel meta-analytic model, sexual abuse became non-significant in the overall association with CU traits. This raises questions about the reliability of measures used for capturing sexual abuse histories. Most studies used self-report without documented evidence or multiple informants. Considerable attention has been paid to the complications surrounding sex abuse victims and non-disclosure (London et al., 2005), delayed disclosure (Goodman-Brown et al., 2003), and recantation after disclosure (Malloy et al., 2007). Victims of sexual abuse are less likely to talk about, remember clearly, or have the ability to recall the abuse in clear, coherent order (Tromp et al., 1995). Future studies should consider using multi-informant approaches where possible to untangle the potential presence of sexual abuse histories in youth with CU traits.

3.4. Strengths and limitations

Despite the strengths of this study, which include a large sample size and a focus on specific forms of maltreatment, some limitations should be acknowledged. First, the majority of studies ($k = 28$) were cross-sectional, which limits inferences about the direction and causal links between maltreatment and CU traits (Kraemer et al., 2000). However, the findings clarify the existence of a positive association warranting longitudinal research to establish developmental processes. Future work should use studies combining prospective and genetically informed designs with measures of parenting and maltreatment to identify aetiological pathways for primary and secondary CU traits and clarify whether maltreatment represents a causal environmental risk factor in both variants of CU traits and psychopathy (De Brito et al., 2021).

Second, more than half of the included studies ($k = 24$, $n = 6,327$) were drawn from clinical and correctional populations, making findings less representative of the general population. Additionally, over half ($k = 19$) of the studies were from the USA leading to an over-representation of that population.

Third, most of the included studies ($k = 25$) used retrospective, self-report measures for childhood maltreatment (e.g., 100% of the correctional youth were assessed with self-report measures), with the remaining four using third-party informants or documented records. Retrospective report is dependent upon accurate memory and compromises data accuracy due to the tendency to reinterpret after subsequent experiences (Kraemer et al., 1997). Self-report measures that use

option-posing prompts (i.e., selection of options or yes/no answers) increase the risk of children guessing or choosing an answer even when not fully comprehending the question (Lamb and Fauchier, 2001). Question type (i.e., open-ended prompting) is one of the strongest predictors of the accuracy of youth informants (Yi and Lamb, 2018) and a recent meta-analysis has called into question the assumption that retrospective reports and prospective measures identify the same populations (Baldwin et al., 2019). That is, 52% of the individuals with prospective observations of childhood maltreatment did not retrospectively report it and conversely 56% of those who retrospectively reported did not have prospective measures, suggesting that both measures cannot be used interchangeably to study risk mechanisms (Baldwin et al., 2019). Similarly, Negriff et al. (2017) found substantial discrepancy between documented and self-reported maltreatment such that 48% of the documented maltreatment was not captured in the self-report measure, and 40% of the self-report disclosures were not indicated in the case documentation. Thus, for youth involved with child welfare services there is substantial discrepancy between what is documented and what is voluntarily disclosed in self-report. Trauma researchers have long reported that victims frequently fail to report abuse or neglect retrospectively. Indeed, Janet (1925a, 1925b) argued that traumatic memories could be inaccessible under ordinary circumstances (Hopper and van der Kolk, 2001). This suggests that severe abuse or neglect memories could be inaccessible to some participants using retrospective self-reporting. Additionally, trauma studies have provided evidence that those who are in a very close relationship with the perpetrator of the abuse or neglect are more likely to delay disclosure, and in many cases do not report it at all (Foyne et al., 2009). This lends credence to the possibility that associations are stronger than those currently reported. Future studies should, where possible, include third-party and documented reporting to clarify and strengthen findings.

Fourth, childhood maltreatment can be operationalized in varied ways with different definitions included (e.g., ACEs, Betrayal Trauma, interpersonal violence, evidence of PTSD symptoms), making it difficult to compare between studies. As a countermeasure, we created strict inclusion/exclusion criteria to select only those studies which measure maltreatment by a primary caregiver (as opposed to early adversity due to socioeconomic risks factors). There is evidence suggesting that maltreatment and other forms of early adversity may not pose the same level of risk (Cyr et al., 2010). Future studies would do well to clarify the important distinction between interpersonal trauma and other forms of risk to strengthen and inform research in areas of childhood maltreatment.

Fifth, we could not examine the association between timing or duration of maltreatment and CU traits because none of the studies reported that information. However, there is good evidence from neuroimaging studies that those factors are important to consider (Teicher et al., 2016). Long-term outcomes may vary depending on when the maltreatment occurs (Kaplow and Widom, 2007) and the cumulative burden of victimization over time (Hamby et al., 2018). It is critical that, where possible, future studies report the age of onset and duration of the maltreatment to elucidate the mechanisms underpinning the association between maltreatment and CU traits.

Sixth, we were unable to analyse associations between primary and secondary variants of CU traits and the maltreatment subtypes due to inconsistencies between studies in how they were defined. However, we created POMP scores from anxiety measures to analyse moderation effects. Future studies should define primary and secondary CU variants by phenotypic characteristics rather than putative risk factors (i.e., maltreatment) to elucidate the role of maltreatment in either variant.

4. Conclusion

The results of this meta-analysis suggest that childhood maltreatment is positively associated with CU traits with moderate effect sizes consistent across overall maltreatment as well as abuse (i.e., physical and emotional) and neglect (i.e., physical and emotional) subtypes. While the observed effect sizes did not show evidence for moderation in most of the moderator analyses, they tended to be stronger in correctional/clinical samples, and to some extent, in younger participants. We were unable to directly investigate associations between primary and secondary CU traits because of inconsistencies with how they are defined. Many studies defined the variants using putative causal or risk factors (i.e., childhood maltreatment) in addition to anxiety, rather than using symptoms alone (i.e., high or low levels of anxiety/internalizing problems). The limitations posed by current research signal the need for clinical and operational guidelines on how to define primary and secondary CU traits. A unified approach must be adopted in future to ensure consistency in research on CU trait variants. Diverse potential explanatory models for the association between CU traits and maltreatment were discussed in relation to the development of both variants and we underscored the need for prospective longitudinal research examining the interplay between caregiving and the development of CU traits using genetically sensitive research designs. It is necessary to establish consistent and reliable methods for investigating primary and secondary CU variants to clarify if childhood maltreatment is a causal risk factor in the development of CU traits and its primary and secondary variants.

Additional contributions

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.neubiorev.2023.105049](https://doi.org/10.1016/j.neubiorev.2023.105049).

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